ACCESSION NUMBER RANGES

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

STAR (N-10000 Series)   N87-15160 — N87-20170
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EARTH RESOURCES

A CONTINUING BIBLIOGRAPHY
WITH INDEXES

Issue 54

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between April 1 and June 30, 1987 in

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

National Aeronautics and Space Administration
Washington, DC
This bibliography was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by RMS Associates.
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 562 reports, articles, and other documents announced between April 1 and June 30, 1987 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 are also included. The bibliography does not contain citations to documents dealing mainly with satellites or satellite equipment used in navigation or communication systems, nor with instrumentation not used aboard aerospace vehicles.

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

Each entry consists of a standard bibliographic citation accompanied by an abstract. The citations include the original accession numbers from the respective announcement journals.

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

- IAA entries identified by accession number series A87-10,000 in ascending accession number order;
- STAR entries identified by accession number series N87-10,000 in ascending accession number order.

After the abstract section, there are seven indexes:

- subject, personal author, corporate source, foreign technology, contract number, report/accession number, and accession number.
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TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED

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ACCESSION NUMBER

N87-13900

TITLE

ANALYSIS OF THE INFLOW AND AIR-SEA INTERACTIONS IN HURRICANE FREDERIC (1979) Final Report

AUTHORS

J. KAPLAN and W. M. FRANK

CONTRACT NUMBER

(Contract NAG5-396)

REPORT NUMBERS

NASA-CR-180014, NAS 1.26:180014

COSATI CODE

Abnormal large amount of aircraft, rawinsonde, satellite, ship and buoy data from hurricane Frederic (1979) are composited over a 40 hr period. These are combined with Frank’s (1984) analysis of Frederic’s core and Powell’s (1982) surface wind analysis to analyze Frederic’s three dimensional low level structure between the storm center and a radius of 10 deg. latitude. The analysis is improved significantly by determining the levels at which low level cloud motion winds (CMW’s) are in the best agreement with verification wind data and then adjusting the winds to uniform analysis levels. Due to the unusually good low level wind resolution afforded by this data set, it is possible to obtain kinematically derived fields of vorticity, divergence and vertical velocity. These analyses are observed to be internally consistent and should prove useful for future analysis. Analysis of Frederic’s surface to 560 m angular momentum budget beyond 2 deg. radius indicates that surface drag coefficients increase slightly with increasing radius and decreasing wind speed. Estimates of storm rainfall obtained by performing a moisture budget between the surface and the top of the inflow layer show that most storm rainfall falls inside about 4 deg. radius and that substantial underestimation of storm rainfall occurs when all low level CMW’s are assigned to 560 m.

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

ON MICROFICHE

ACCESSION NUMBER

A87-14176

TITLE

VARIABILITY OF EARTH-EMITTED RADIATION FROM ONE YEAR OF NIMBUS-6 ERB DATA

AUTHOR

T. D. BESS (NASA, Langley Research Center, Hampton, VA)

JOURNAL TITLE

Journal of the Atmospheric Sciences (ISSN 0022-4928), vol. 43, July 15, 1986, p. 1445-1453

Outgoing longwave radiation (OLR) measurements from the Nimbus-6 ERB wide field-of-view instrument are used to study daytime and nighttime radiation variability on a 15 deg. regional, zonal, and global scale. An analysis of components of variance is used to determine how much of the total variability is due to between-region and within-region variance. Most of the analysis is on July and January data from one year of Nimbus-6 ERB. Different geographical scales are considered: regions within latitude zones and latitude zones within hemispheres. Results show that much of the variability is spatial, peaks in the tropics and subtropics, and is concentrated in the Northern Hemisphere. Daytime variability is generally larger than nighttime variability for July but not for January. Variance in OLR in the tropics and subtropics is largely a function of cloud variability.
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.

A87-20671
AN INITIAL EVALUATION OF TWO DIGITAL AIRBORNE IMAGERS FOR SURVEYING SPRUCE BUDWORM DEFORESTATION
F. J. AHERN (Department of the Environment, Canada Centre for Remote Sensing, Ottawa), W. J. BENNETT (INTERA Technologies, Ltd., Ottawa, Canada), and E. G. KETTELA (Canadian Forestry Service, Maritime Forest Research Centre, Fredericton, Canada) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, Oct. 1986, p. 1647-1654. refs

The comparative effectiveness of mechanized and pushbroom airborne multispectral scanners in detecting differences in budworm defoliation is investigated on the basis of data obtained in flights over a test site in New Brunswick, Canada, during July 1983. The data are presented in tables, graphs, and sample images and characterized. The superior performance of the pushbroom scanner is attributed to its higher spectral resolution. T.K.

A87-20758
REMOTE SENSING OF THE STATE OF CROPS AND SOILS
K. I. KONDRAFEEV (AN SSSR, Institut Ozerovedeniia, Leningrad, USSR), V. V. KOZODEROV (AN SSSR, Otdel Vychislitel'noi Matematiki, Moscow, USSR), and P. P. UDENKO (Vsesouznyi Nauchno-Isledovatel'skii Institut Sel'skokhoziastvennoi Meteorologii, Obrninsk, USSR) International Journal of Remote Sensing (ISSN 0143-1161), vol. 7, Oct. 1986, p. 1213-1235. refs

Various techniques as well as some general problems of agricultural remote sensing are discussed, with emphasis on the development of techniques to assess soil productivity (humus content) and the state of crops (weediness, etc.). The techniques considered were tested for the conditions of the southern part of the USSR European territory (the Ukraine and Moldavia). Sample applications of the technique are shown. Author

A87-20759
MACHINE PROCESSING OF LANDSAT DATA FOR SOIL SURVEY - THE BENUE VALLEY SAVANNA CASE STUDY

A ground-truth (GT) map, produced by fieldwork and the interpretation of large-scale B&W aerial photographs, was compared with digital/graphical output from Landsat data of the savanna around Makurdi in central Nigeria. The GT maps were digitized, grid-converted and then aggregated, while the Landsat data were resampled for the purpose of rectification on the ERDAS 400 microcomputer at Michigan State University. A visual comparison of the maps was done by overlaying the digital maps on the GT map, while the histogram listing provided an approximate quantitative comparison. Two algorithms of supervised classification (maximum likelihood and minimum distance) produced similar results, but the third unsupervised algorithm, (cluster analysis), produced a far simpler map that is ideal as a reconnaissance soil/resource survey map. Author

A87-20761* New York State Univ., Binghamton.
ESTIMATION OF CANOPY PARAMETERS FOR INHOMOGENEOUS VEGETATION CANOPIES FROM REFLECTANCE DATA. II - ESTIMATION OF LEAF AREA INDEX AND PERCENTAGE OF GROUND COVER FOR ROW CANOPIES

The canopy reflectance (CR) model for row-planted vegetation proposed earlier has been tested for soybean canopies in three different stages of growth and for corn canopies at early and full growth stages. The model fits the field-measured bidirectional CR data quite well. It is shown that, by inverting this model, one could estimate the leaf area index as well as the percentage of ground cover quite accurately from measured canopy reflectances. Author

A87-20762
THEMATIC Mapper ANALYSIS OF CONIFEROUS FOREST STRUCTURE AND COMPOSITION
J. FRANKLIN (California, University, Santa Barbara) International Journal of Remote Sensing (ISSN 0143-1161), vol. 7, Oct. 1986, p. 1287-1301. Research supported by the University of California. refs

Simple regressions of single-band TMS reflectance data against stand basal area and leaf biomass show that the spectral feature most strongly related to vegetation amount is visible reflectance (TM bands 1, 2, and 5), which decreases as conifer basal area increases. Principal-components analysis of TMS spectral data for sample stands, and stepwise multiple regression of transformed axes, showed the first principal component, interpreted as scene brightness, to be the composite spectral feature most correlated to vegetation amount. TMS data showed some ability to discriminate spectrally between coniferous forest stands dominated by different species. Author

A87-20763* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ASSESSING FOREST DECLINE IN CONIFEROUS FORESTS OF VERMONT USING NS-001 THEMATIC MAPPER SIMULATOR DATA

This study evaluates the potential of measuring/mapping forest decline in spruce-fir forests using airborne NS-001 TMS data. Using field instruments, it was found that ratios of 1.65/1.23 and 1.65/0.83-micron reflectance discriminated between spruce samples of low and high-damage sites. Using TMS data, band ratios were found to be strongly correlated with ground-based measurements of forest damage. Ratio colo-density slice images using these band ratios, and images using 0.56 and 1.65-micron bands with either of these band ratios in a false-color composite,
provide accurate means of detecting, quantifying and mapping levels of forest decline.

**A87-21240**  
**NMR INSTRUMENT FOR SOIL MOISTURE GROUND-TRUE DATA COLLECTION**


Research was conducted to develop an instrument capable of measuring volumetric soil-water content using nuclear magnetic resonance (NMR) techniques. NMR is very attractive since it is both non-destructive and non-invasive. An NMR instrument was designed to continuously measure volumetric water content in the soil surface while moving at ground speeds of up to 17 km/h. The instrument will be used to gather ground data for calibration and verification of data collected by remote sensing instruments. This use requires a method that is relatively accurate, rapid and independent of soil type, organic matter content, texture and clay mineralogy. Calibration measurements were made on large soil samples with varying water content. The average correlation coefficient of the NMR results with the soil moisture content for six combinations of measurement depth and sensor configuration was 0.97.

**A87-21242**  
**SPECTRAL BRIGHTNESS AND SURFACE SOIL CHARACTERISTICS IN AN ARID MEDITERRANEAN REGION (SOUTHERN TUNISIA) [LUMINANCE SPECTRALE ET CARACTERES DE LA SURFACE DES SOUS EN REGION ARIDE MEDITERRANEENNE /SUD TUNISIEN]**

RICHARD ESCADAFALE (Office de la Recherche Scientifique et Technique Outre-Mer, Gabes, Tunisia) and MARCEL POUGET (Office de la Recherche Scientifique et Technique Outre-Mer, Bondy, France) (Working Group on Remote Sensing for Soil Survey, Symposium, Wageningen and Enschede, Netherlands, Mar. 3-8, 1985) ITC Journal (ISSN 0303-2434), no. 1, 1986, p. 19-23. refs

The application of thematic mapper (TM) data to soil mapping is studied. The basic capabilities and operation of the TM are described. The TM provides improved spatial resolution, spectral resolution, and band allocation. The TM was utilized to evaluate the gypsiferous, calcareous, and clayey surfaces of the Kasserine and Setifini areas in Tunisia; the generated TM maps are compared with aerial photographs. It is noted that the TM is useful for soil mapping in arid area if combined with aerial photographs. I.F.

**A87-21243**  
**THE THEMATIC MAPPER - A NEW TOOL FOR SOIL MAPPING IN ARID AREAS**


The structure of thematic mapper (TM) data was investigated using various methods to assess the information content for an area in North Africa. One of the most effective methods of displaying TM data was obtained by using ratio images in combination with total intensity images. This allowed preparation of thematic maps which could be subsequently checked during fieldwork.

**A87-21245**  
**AN APPLICATION OF THEMATIC MAPPER DATA IN TUNISIA - ESTIMATION OF DAILY AMPLITUDE IN NEAR-SURFACE SOIL TEMPERATURE AND DISCRIMINATION OF HYPSERSALINE SOILS**

MASSIMO MENTENI, ALOISIUS LORKEERS, and MARTIN VISSERS (Landbouwogeschool, Wageningen, Netherlands) (Working Group on Remote Sensing for Soil Survey, Symposium, Wageningen and Enschede, Netherlands, Mar. 3-8, 1985) ITC Journal (ISSN 0303-2434), no. 1, 1986, p. 35-42. refs

To evaluate aerial thermography for soil moisture mapping, thermal images of an agricultural area in central Sweden were obtained in the early afternoon and the following night. Eighty soil samples were analyzed with respect to volumetric water content, grain size distribution, porosity and organic material. Aluminium plates were placed at the sampling sites for location in the thermal images. Analysis of the relationship between thermal image data and soil moisture was performed.
and soil data showed a significant correlation between soil moisture and temperature in both day and nighttime images. The accuracy increased considerably with the addition of meteorologic data and soil type information in the interpretation procedure. Author

A87-21247
THERMOGRAPHY - PRINCIPLES AND APPLICATION IN THE OOST-GELDERLAND REMOTE SENSING STUDY PROJECT

A study project conducted in The Netherlands is described in which both thermal images and agro-hydrologic models were assessed. Linear relationships were established between the increase in crop surface temperature derived from thermal images and the reduction in daily evapotranspiration. With these relationships, digital images in the visual and thermal infrared spectral regions could be transformed automatically into an evapotranspiration map. Thromography was found valuable in itself and also as an important check for the agro-hydrologic models. The two techniques correlated reasonably well in estimating the hydrologic regime in a mostly agricultural area. Author

A87-21249
TIMELY THERMAL INFRARED DATA ACQUISITION FOR SOIL SURVEY IN HUMID TEMPERATURE ENVIRONMENTS

A87-21250
THEORETICAL APPROACH TO RADAR BACKSCATTERING OF SOILS

Models which describe the relationship between the radar signal and the object parameters for radar-based remote sensing are developed. The models need to predict the amplitude and phase of the scattered wave as a function of polarization, incidence angle, and wavelength of the illuminating wave. The material properties are expressed in terms of a dielectric constant and the structural interaction effects are classified into Rayleigh, Mie, and optical regions. Procedures and equations for solving the electromagnetic field problem are presented. A procedure for simulating the backscattering of soil is described. I.F.

A87-21251
RADAR IMAGES FOR SOIL SURVEY IN ENGLAND AND WALES
ROBERT EVANS (Cambridge University, England) and DOUGLAS M. CARROLL (Working Group on Remote Sensing for Soil Survey, Symposium, Wageningen and Enschede, Netherlands, Mar. 3-8, 1985) ITC Journal (ISSN 0303-2434), no. 1, 1986, p. 89-93. refs

A87-23360
FOREST FIRE MONITORING USING THE NOAA SATELLITE SERIES


The degree to which the GOES-VISSL infrared data can be used to infer area-averaged soil moisture is explored for a five-day case study period. Chosen variables are transformed and incorporated into a multiple linear regression. The actual observations, rather than a simplified model, are used to determine the relationship between soil moisture and GOES-IR radiance. It is shown that a depletion coefficient of 0.92 produces an index of ground truth which is best correlated with soil moisture as inferred from GOES thermal infrared data. When all individual daily soil estimates during the case study period are averaged at each point and compared to the average observed soil moisture, the data correlate at 0.85. This implies that the algorithm can distinguish at least four categories of soil moisture.

A87-23389
SOIL MOISTURE ESTIMATES FROM SATELLITE INFRARED TEMPERATURES AND THEIR RELATION TO SURFACE MEASUREMENTS

The use of a time-dependent, initial-valued, one-dimensional boundary layer model in conjunction with measured surface temperatures to obtain the surface energy balance, a soil moisture parameter called the moisture availability, and the thermal inertia of the soil is addressed. Recent results are reported which show agreement between moisture values calculated with the model using satellite infrared temperatures as input and ground-based measurements of related parameters. The approach can detect large spatial and temperature changes in soil moisture but cannot yet provide a completely consistent measure of the real soil water content or the soil depth over which it applies.

A87-23797
AN ITERATIVE LANDSAT-MSS CLASSIFICATION METHODOLOGY FOR SOIL SURVEY

A procedure for the integration of digital Landsat multispectral scanner and photographic remotely sensed data into pre-mapping activities of a soil survey was developed and tested for 170,000 hectares of southern Arizona rangeland. Image enhancement, classification and stratification of the digital data were used to derive output products employed to accelerate field sampling site selection and mapping. Digitized map data on established ground sites and the thermic/hyperthermic temperature boundary were overlayed with classified MSS data to produce a second-order classification for improved soil map units. Benefits from this methodology included the design of more appropriate map units, enhanced prediction of soil occurrence outside of the intensively studied field sites, creation of a digital data base for the resulting general soils map and time savings during subsequent detailed mapping. Author
A87-23806
AGRICULTURAL REMOTE SENSING IN SOUTH CAROLINA - A STUDY OF CROP IDENTIFICATION CAPABILITIES UTILIZING LANDSAT DATA

Remote sensing of agricultural resources in the southeastern United States is constrained both by relatively small field sizes and by persistent cloud cover during the growing season. This study examined the crop identification capabilities of Landsat MSS data during the summer of 1980 when only one date of imagery of acceptable quality was available. The phenological calendars of four major crops (soybeans, corn, cotton, and tobacco) were prepared, and the theoretical discriminability evident in the spectral reflectance curves of the crops was compared to actual results. The Landsat data were transformed using Kauth-Thomas and principal component analyses, and supervised and unsupervised classifications were performed on all three sets of imagery. There was no major change in overall classification accuracy associated with the transformed data, but the classification accuracies of the unsupervised classifications were significantly higher than the supervised classifications. The unsupervised classification of the principal component data yielded the highest information content and had an overall accuracy of 65.9 percent. Author

A87-23807
USING LANDSAT TO ASSESS TROPICAL FOREST HABITAT FOR MIGRATORY BIRDS IN THE YUCATAN PENINSULA

A87-23811
LAND SURFACE CLIMATIC VARIABLES MONITORED BY NOAA-AVHRR SATELLITES

Data collection and analysis has begun at the National Environmental Satellite Data and Information Service to determine the usefulness of satellite data for monitoring land surface climatological variables. The objective of this study is to determine if relationships can be developed between satellite obtained information and routine available ground-based quantities such as the crop moisture index (CMI), Palmer drought index (PDI), soil moisture status, and shelter temperature. Collection of satellite data from the Great Plains area of the United States has begun and includes mapped Global Area Coverage data from the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA-9 satellite. Conventional (ground-based) weather observations are accessed daily from the National Meteorological Center’s operational data files. Derived climatic indices (CMI, PDI, etc.) produced by the NOAA Climate Analysis Center are acquired on a weekly basis and merged with the AVHRR data for further analysis. The coincident satellite and ground data will be used to evaluate AVHRR data and products with respect to ground observations. Author

A87-23816
AN ASSESSMENT OF EVAPOTRANSPIRATIONAL WATER LOSSES IN A SIERRAN MIXED CONIFER FOREST USING REMOTELY SENSED DATA

A87-23818
PHENOLOGICAL EFFECTS ON GRASS CANOPY/SPECTRAL RELATIONSHIPS

The utility of the Landsat Thematic Mapper bands for estimating grass canopy variables during three different phenological stages was studied. Spectral data were collected from annual ryegrass (Lolium multiflorum) plots using in situ remote sensing techniques with a Barnes Modular Multiband Radiometer. Data sets were collected at three plant stages; early stem extension (June), anthesis (July), and senescence (August). The highest correlations between the spectral and canopy variables were found for the June data set while the August data set yielded the poorest relationships. High levels of biomass (July) and plant senescence (August) both adversely affected the reflectance/canopy relationships. Principal component analysis was successful at reducing the seven original spectral bands to only two dimensions while maintaining nearly all of the variability found in the original data. Author
A87-23819
ESTIMATION OF DENSITY IN YOUNG PINE PLANTATIONS USING 35MM AERIAL PHOTOGRAPHY
In this study, stem counts were determined for plots established in young pine plantations using 35 mm vertical aerial photography. Color slides, at a scale of 1/6000, taken during the fall color change period provided the basis for this interpretation. A difference in the photo-obtained stem counts and those obtained in ground appraisals of the plots was observed. The age of the plantation being evaluated seemed to have an effect on the results, with the youngest stand showing the strongest relationship between the ground and photo counts.

A87-23822
DIURNAL-SEASONAL LIGHT INTERCEPTION, LEAF AREA INDEX, AND VEGETATION INDEX INTERRELATIONS IN A WHEAT CANOPY - A CASE STUDY
Diurnal measurements of photosynthetically active radiation (PAR), intercepted by wheat canopies (IPAR), were adjusted for solar zenith angle (Z) effect on canopy solar path length and related to leaf area index (LAI) and perpendicular vegetation index (PVI) for semidwarf durum wheat (cv. Yavaros). Solar zenith angle adjustments permitted diurnal-seasonal IPAR data obtained during the canopy development portion of the 1983-1984 growing season to be correlated with LAI/cosZ and with the PVI calculated from diurnal radiometer radiances. Regressing IPAR data from light bar sensors against LAI/cosZ and PVI yielded IPAR = 1.0 -0.96exp(-0.78 LAI/cosZ) and IPAR = 1-3.26exp(-0.144 PVI). Also, LAI/cosZ = 0.155exp(0.116 PVI). These studies indicate that LAI and IPAR are associated with spectral data such as the PVl since senescence begins. Correlation ranged from r squared = 0.86 to 0.94. The PVI appeared sensitive over a greater LAI/cosZ range than the normalized difference. These relations may be useful for large-scale agrometeorological crop growth models driven by satellite acquired spectral data.

A87-23830
GEORGE MASON UNIV., FAIRFAX, VA.
LANDSAT THEMATIC MAPPERS: DIGITAL INFORMATION CONTENT FOR AGRICULTURAL ENVIRONMENTS
(refs (Contract NAS7-918))
LandSat Thematic Mapper (TM) data collected for Imperial Valley, California in December, 1982 were analyzed to assess their utility to distinguish among agricultural and other land-covers. Statistics for thirty-seven training sites representing a variety of crops plus urban, water and desert land-covers were obtained and analyzed using transformed divergence (TD) calculations. TD values were employed to assess intraclass variability and the best bands for classification. Four subscenes were selected for clustering or unsupervised signature extraction. These areas were agriculture, urban, desert and water land-covers. The number of clusters for these subscenes were examined and the best TM bands for interclass separability were identified. The results of the clustering and training site analyses for interclass separability were compared. The TM data were useful for the digital delimitation of most crops and other cover types in this analysis. Four bands of data are adequate for classification with the best results obtained by the selection of one band from each of the available portions of the electromagnetic spectrum. Different band combinations are best for various land-cover intraclass separability.

A87-23832
IDENTIFICATION OF FOREST AND AGRICULTURAL EDGES USING LANDSAT THEMATIC MAPPER DATA - PRELIMINARY RESULTS
Research supported by the Storrs Agricultural Experiment Station. refs Portions of a Landsat 4 Thematic Mapper (TM) scene imaged October 19, 1982 were analyzed to identify vegetation 'edges' (boundaries between cover types). Three study sites in northeastern Connecticut were used to determine the effectiveness of using TM data to identify both forest and agricultural cover types and edges between these covers. Channels 3, 4, 5, and 6 (middle IR) were the most effective bands for accurate cover type classification based on an evaluation of maps produced utilizing various channel combinations. Also, a channel consisting of spectral texture data was evaluated in several analyses to evaluate its ability to affect edge classification. Maps identifying only homogeneous cover types had consistently higher overall accuracy values compared to maps identifying edge cover types.

A87-23833
VEGETABLE CROP INVENTORY WITH LANDSAT TM DATA - PRELIMINARY RESULTS
USDA-supported research.
Landsat thematic mapper (TM) data are being evaluated for inventoring or monitoring the planted areas of vegetables in New York State. TM scenes for western New York were acquired in July and August 1984, and were analyzed digitally with spectral characterizations, enhancements, and supervised classifications being compared to field-measured reflectances and cropping records. Preliminary testing has shown single-date classification accuracies of at least 85 percent for three vegetable species grown on organic soils (muckland), and over 70 percent for 3 of 4 vegetables grown on mineral soils (upland).

A87-24388
A PHOTOGRAPHIC TECHNIQUE FOR STUDYING REFLECTION INDICATRIXES OF VEGETATION COVER [FOTOGRAFICHESKII SPOSOB IZUCHENIIA INDIKATRIS OTRAZHENIIA VEGETATION COV]
In Russian.
A photographic method for measuring the reflection indicatrixes of a canopy is presented, using a camera with a 180-deg field-of-view for rapid aerial photography. Three-dimensional plots of indicatrixes obtained for a birch forest and a barley field are compared with the plot calculated from the Nilson-Kuusk (1984)
model. The advantages and drawbacks of the photographic method of indicatrix determination are compared with those of direct photometric measurements.


Leaf structure and function are shown to result in distinctive variations in the absorption and reflection of solar radiation from plant canopies. The leaf properties that determine the radiative-interception characteristics of plant canopies are directly linked to photosynthesis, stomatal resistance and evapotranspiration and can be inferred from measurements of reflected solar energy. The effects of off-nadir viewing and atmospheric constituents, coupled with the need to measure changing surface conditions, emphasize the need for multitemporal measurements of reflected radiation if primary production is to be estimated.

Author


Images at a resolution of 8 km are currently being generated for the whole of Africa, displaying the normalized difference vegetation index (NDVI). These images have undergone a process of temporal compositing to reduce the effects of cloud cover and atmospheric variation. When the NDVI is plotted against time, different cover types are shown to have characteristic profiles corresponding closely with their phenomenology. The resultant pattern of NDVI values displayed on the images is analyzed in terms of the cover types present and local variations in rainfall. Comparison between images for 1983 and 1984 overall showed considerable similarities, but significant differences were observed in the northward extent of the greening wave in the Sahel, the greening up of the Kalahari Desert and East African communities. It is concluded that vegetation monitoring using NDVI images needs to be associated with scene stratification according to cover type.

Author


AVHRR images collected in August and September 1983 and 1984 displaying drought conditions in Ethiopia are compared. The normalized difference vegetation indices and difference ratios of IR and red reflectances are analyzed. The vegetation growth and topography detected from the images and the climate of Ethiopia are described. The effects of topography and a reduction in rainfall during August 1984 on vegetation growth are discussed.

I.F.


NOAA Advanced Very High Resolution Radiometer satellite data are applied to regional vegetation monitoring in East Africa. Normalized Difference Vegetation Index (NDVI) data for a one-year period from May 1983 are used to examine the phenology of a range of vegetation types. The integrated NDVI data for the same period are compared with an ecoclimatic zone map of the region and show marked similarities. Particular emphasis is placed on quantifying the phenology of the Acacia Commiphora bushlands. Considerable variation was found in the phenology of the bushlands as determined by the satellite NDVI, and is explained through the high spatial variability in the distribution of rainfall and the resulting green-up of the vegetation. The relationship between rainfall and NDVI is further examined for selected meteorological stations existing within the bushland. A preliminary estimate is made of the length of growing season using an NDVI thresholding technique.

Author


A ground data-collection program was initiated to establish a calibration between the normalized difference vegetation index (NDVI) from the NOAA Advanced Very High Resolution Radiometer (AVHRR) and grassland biomass. Thirty sites were selected representing a range of Sahelian vegetation communities in the Gourma region of Mali and monitored during the 1984 growing season. The herbaceous and woody strata were sampled every fourteen days, and above-ground green biomass and rainfall data were collected. NDVI values were extracted for the ground sites and correlation analysis performed. Low correlation coefficients were calculated for the ground measured green biomass and satellite NDVI (0.67). The correlation between the maximum NDVI and the total biomass produced during the season was 0.73. A value of 0.05 was determined as the NDVI associated with the minimum vegetation cover identifiable by the satellite (100 kg/ha). Explanation is given for the possible causes for such low correlations, including the very low biomass production associated with the 1984 drought conditions, atmospheric haze and dust and poor locational accuracy of the satellite data.

Author
A87-24785
SATellite remote SENSING OF Rangelands in Botswana. I - Landsat MSS and Herbaceous Vegetation

The ability of Landsat MSS data to measure palatable forage of vegetation is examined. The relationships between MSS data and ground measurements of vegetation in three sites in Botswana during the 1983-1984 growing season are studied; the sites and vegetation observed include the Colophospermum mopane woodland in Tamasane, the Combretum apiculatum-Acacia nigrescens woodland in Shakwe, and the Terminalia sericea woodland in Masama. The canopy cover and biomass of live and dead herbaceous vegetation and the canopy cover of trees and shrubs were measured. The data reveal that there is a positive relationship between live herbaceous biomass and band ratio; however, the correlation between herbaceous vegetation cover and band ratio is more variable than for biomass. Multiple regression analysis and multitemporal integration were applied to the band ratios. It is noted that cover, biomass, and production of herbaceous vegetation can be accurately measured using the MSS. Graphs of canopy cover and biomass for ground measurements and MSS are presented. I.F.


The relationship between the normalized difference vegetation index (NDVI) and the herbaceous vegetation in Tamasane, Shakwe, and Masama in eastern Botswana is studied using 1983-1984 AVHRR data. The procedures for Landsat MSS interpolation of ground measurements and the data processing of the AVHRR data are described. The temporal sequence AVHRR global-area coverage (GAC) composite NDVI is examined. The AVHRR GAC composite NDVI and biomass and Landsat MSS interpolations of field measurements are analyzed and compared. I.F.

A87-24787* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md. MONITORING THE GRASSLANDS OF THE SAHEL 1984-1985

Normalized difference vegetation index data obtained from polar-orbiting meteorological satellites were used to compare the growing or rainy seasons of 1984 and 1985 for the Sahelian zone of Africa. A substantial difference was found between these two years, with 1985 generally having higher normalized difference vegetation index values indicating higher levels of primary production in 1985 than in 1984. 1 km data were compared for Senegal, Mali, Niger and Sudan, and 7 km data were compared for sub-Saharan Africa. The qualitative comparison of these data suggests the use of similar data to assist in centralized monitoring of rangeland conditions, to identify areas of deficiencies in primary production and provide synoptic information in support of regional drought monitoring. Author

A87-24788 GROWING PERIOD AND DROUGHT EARLY WARNING IN AFRICA USING SATELLITE DATA

A87-24789* Food and Agriculture Organization of the United Nations, Rome (Italy). ASSESSMENT OF ECOLOGICAL CONDITIONS ASSOCIATED WITH THE 1980/81 DESERT LOCUST PLAGUE UPSURGE IN WEST AFRICA USING ENVIRONMENTAL SATELLITE DATA

A87-24933* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. Aircraft and Satellite Thermographic Systems for Wildfire Mapping and Assessment

Two complementary sensors, the daedalus DE1-1260 multispectral Scanner aboard the NASA U-2 aircraft and the Advanced Very High Resolution Radiometer aboard National Oceanographic and Atmospheric Administration orbiting satellites were tested for their applicability in monitoring and predicting parameters such as fire location, temperature and rate of spread, soil heating and cooling rates, and plume characteristics and dimensions. In addition, the satellite system was tested for its ability to extend the relationships found between fire characteristics and biospheric consequences to regional and global scales. An overall system design is presented, and special requirements are documented for the application of this system for fire research and management. Author

A87-25586 THE SPECTRAL REFLECTANCE OF STANDS OF NORWAY SPRUCE AND SCOTCH PINE, MEASURED FROM A HELICOPTER

Radiometer measurements were made from a helicopter over selected stands of Norway spruce (Picea abies) and Scotch pine (Pinus sylvestris) near Stockholm, Sweden. Continuous reflectance spectra in the wavelength range of 0.4-1.7 microns were measured over selected stands having different species, ages, crown densities, and understories. The irradiance was measured continuously with a cosine receptor on board the helicopter. The average reflectances of pine stands with an age over 40 years were higher in all bands than the reflectances for comparable spruce stands. In rank order, bands centered at 0.67, 1.6, and 0.48 microns offered the best separation possibilities. The reflectance changes through the summer for the two species were small. The reflectance of the pine stands varied less with deviations in look angle away from the nadir than the reflectance of the spruce stands. Author

A87-25589 Moorland Plant Community Recognition Using Landsat MSS DATA

Landsat MSS data are examined to determine what extent moorland plant community types can be recognized in the Plynlimon area of Wales. A detailed comparison is made between spectral radiance data and community composition. Attention is drawn to the importance of a phenological understanding of the different plant species and in particular the proportions of living and standing

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dead plant parts as an important aid to distinguishing between species and communities.  

Author A87-25590

ASSESSMENT OF GRASSLAND PHYTOMASS WITH AIRBORNE VIDEO IMAGERY 

Airborne video imagery was evaluated for assessing phytomass production within grass plots fertilized with five rates of nitrogen. Video imagery was taken with two black-and-white video cameras, one visible light and the other visible/near-infrared light sensitive. Red and infrared narrowband filters were used with the visible and visible/near-infrared light sensitive cameras, respectively. Hemispherical red and infrared radiometric reflectance and phytomass measurements were made on the day that imagery was obtained. Red and infrared digital video data were obtained from the plots using an image processor. The plots were studied on two dates: April 15 and May 22, 1985. On April 15, three phytomass levels could be distinguished within the infrared video image. Moreover, a infrared/red ratio video composite produced on an image processor enhanced differences among nitrogen treatments to the extent that generally four levels of phytomass could be identified. Coefficients of determination, obtained by regressing red, infrared, and infrared/red reflectance, and red, infrared, and infrared/red digital video data on phytomass measurements were significant statistically. Imagery acquired on May 22, however, showed few differences among treatments. This may have been caused by plant phenological and canopy architectural differences among the grass species. Nevertheless, video imagery should be a useful tool to assess phytomass production on rangelands when grasses are actively growing. 

Author A87-26197

REMOTE DETECTION OF FOREST DAMAGE 

The use of remote sensing to discriminate, measure, and map forest damage is evaluated. TM spectral coverage, a helicopter-mounted radiometer, and ground-based surveys were utilized to examine the responses of the spruces and firs of Canels Hump Mountain, Vermont to stresses, such as pollution and trace metals. The basic spectral properties of vegetation are described. Forest damage at the site was estimated as 11.8-76.0 percent for the spruces and 19-43.8 percent for the balsam firs. Shifts in the spectra of the conifers in particular in the near IR region are analyzed, and variations in the mesophyll cell anatomy and pigment content of the spruces and firs are investigated. The relations between canopy moisture and damage is studied. The TM data are compared to aircraft data and found to be well correlated. 

Author A87-26774

PROPOSAL OF A REMOTE SENSING METHOD FOR MEASURING SOIL MOISTURE OF BARE SOILS IN THE FREQUENCY RANGE 100 MHZ-1 GHZ 

A flexible interactive scheme is presented for computer-aided thematic processing of space imagery of large crop areas, which can be applied to different classes of problems related to crop status. The thematic processing software is built around nonparametric stochastic segmentation and controlled classification packages. To illustrate the potential of this scheme, space imagery, obtained with the Fragment multispectral scanner aboard the Meteor satellite) of a territory 90 km wide and with an area of 27,000 sq km made it possible to evaluate the plowed horizon in terms of its two most significant components, humus and carbonate, as well as soluble salts, iron, and silica. 

Author A87-26539

AUTOMATION OF THEMATIC PROCESSING OF SPACE IMAGES IN EVALUATING CROP CONDITION [AVTOMATIZATSIIA TEMATICHESKOI OBRABOTKI KOSMIHESKIH IZOBRAZHENII PRI OTSEKI SOSTOIANIIA SEL'SKOHOSIAISTVENNYKH KULTUR] 

A flexible interactive scheme is presented for computer-aided thematic processing of space imagery of large crop areas, which can be applied to different classes of problems related to crop status. The thematic processing software is built around nonparametric stochastic segmentation and controlled classification packages. To illustrate the potential of this scheme, space imagery, obtained with the Fragment MSS over fields of winter wheat in the Stavropol Region, is analyzed with respect to wheat condition, classifying wheat crops into good, medium, and poor. 

Author A87-26974

MEASURING SOIL MOISTURE OF BARE SOILS IN THE FREQUENCY RANGE 100 MHZ-1 GHZ 

refs
developed for major soil types which significantly predict the amount of trees and shrubs present on a site.

A87-29004

ESTIMATING PRE-HARVEST PRODUCTION OF MAIZE IN KENYA USING LARGE-SCALE AERIAL PHOTOGRAPHY AND RADIOMETRY


A87-29005

ESTIMATING AND MAPPING GRASS COVER AND BIOMASS FROM LOW-LEVEL PHOTOGRAPHIC SAMPLING


Using data obtained of 700 sq km in Botswana in four seasonal surveys, it is found that low-level aerial photography can provide accurate estimates of grass cover and biomass at any season, and that kringing can predict these estimates with adequate precision over a region of several hundred square kilometers. Sample semivariograms were modeled as anisotropic power functions to 90 km by least square approximation, and grass cover and biomass were mapped from the sample data by interpolating a figure field of cover on a line mesh by kringing, and then contouring the figure field. A strong region was noted which remains fairly constant at different seasons and from which four distinct subregions are delineated, with biomass ranging from 185-1700 kg/ha.

R.R.

A87-29006

COMPARISON OF SOME CLASSIFICATION METHODS ON A TEST SITE (KISKORE, HUNGARY) - SEPARABILITY AS A MEASURE OF ACCURACY


The purpose of this study was to compare some classification methods on a typical Hungarian lowland agricultural area. For a multicrop test area of approximately 20,000 ha several one-date and multidate Landsat MSS data sets were classified using supervised methods. The best results were obtained by clustering two-band Kauth-Thomas transforms for each date, using Swain-Fu intercluster distance. In general, clustering Kauth-Thomas bands always showed slightly better accuracy than the ones for the MSS 5 and MSS 7 data sets. The accuracies achieved by polygon-vector classification were lower (3-6 percent) than those of multidate clustering. An effort was made to explain the results in terms of spectral separability of agricultural cover classes. The ratio of the average separability of an individual class and the total data set is proposed to measure classification accuracy on areas similar to the Kiskore test site.

A87-29008

CALIBRATION OF LANDSAT DATA FOR SPARSELY VEGETATED SEMI-ARID RANGELANDS


A Landsat-based rangelands monitoring system has been designed for semi-arid chenopod shrublands in southern Australia. Simultaneous ground and Landsat measurements were used to test multivariate calibration methods for estimating vegetation cover. Of three methods compared, the Lwin-Maritz and inverse estimators outperformed the classical approach. Data were analyzed by rangeland type and as a combined set. Calibration...
curves, with errors of estimation, are presented for five major rangeland types.  

**A87-29017**

**PRELIMINARY ANALYSIS OF SPOT HRV MULTISPECTRAL PRODUCTS OF AN ARID ENVIRONMENT**


A preliminary analysis of a SPOT HRV multispectral scene centered on the Chott el Djerid in southern Tunisia is presented. All three HRV bands are very strongly correlated for this scene, and there are systematic changes in the variability within vegetated areas. Each of the three bands has discriminatory potential. Inter-detector variability is clearly visible in HRV band 2, and there are also systematic changes in level. The improved spatial resolution of the HRV sensor is notable, compared with the Thematic Mapper.

**A87-30129**

**EXTRACTION OF AREAS INFESTED BY PINE BARK BEETLE USING LANDSAT MSS DATA**


Areas infested by pine bark beetle (pine nematode) in Japan have been expanding in recent years. Two sites in heavily infested areas of Ibaragi and Chiba Prefectures were selected as study areas. Images of the study areas were generated from two temporal Landsat MSS scenes. Pine areas were extracted by multispectral classification using the four bands composed of bands 5 and 6 for each of the scenes. The areas infested by the pine bark beetle were extracted by detecting the areas where the value of band 5 increased and the value of band 6 decreased within the pine areas. The infested areas could be classified into light, moderate, and heavy damage in proportion to the increase of band 5 and the decrease of band 6. Ground surveys were collected by local government forestry officials to estimate damage volume. There was a high correlation ($r = 0.824$) between the timber volume of the damaged pines estimated from Landsat data and that surveyed on the ground.

**A87-30130**

**MICROCOMPUTER-ASSISTED VIDEO IMAGE ANALYSIS OF LODGING IN WINTER WHEAT**


Microcomputer-assisted video image analysis (VIA) was used to measure lodging in winter wheat, a symptom of foot rot disease. The percent area infested in the winter wheat in seven fields was measured from 35-mm true color and color-infrared aerial photos and from manually prepared photointerpretations made onto frosted Mylar sheet. Lodged wheat areas measured from these standard images ranged from 0.5 to 7.6 ha per field. Measurements made directly from photos consistently underestimated lodging by 0.2 to 2.4 ha per field relative to measurements from the standard images. Manual measurement of foot rot symptoms and grain yield in the seven fields showed 9 percent more severe lesions, and grain yield reductions of 1389 to 3416 kg/ha, in lodged wheat relative to erect wheat. Yield measurements combined with VIA lodging measurements made from the standard images showed the lodging-foot rot complex reduced yields by 136 to 796 kg/ha per field.

**A87-30894**

**GROUND RADIOMETRY AND AIRBORNE MULTISPECTRAL SURVEY OF BARE SOILS**


Soil survey data collected in southern and eastern England are examined in order to describe the intercalibration between measurements made at ground level and by the Airborne Thematic Mapper (ATM). The effects of solar-sensor geometry and cultivation practices on intercalibration are investigated. The relation between ATM reflectance and ground reflectance is analyzed. It is observed that the reflectances correlate well at the first three bands; however, for the middle IR band the ATM values are higher than the ground level data. The soil surface data reveal that only the samples close to nadir show good correlation with the reflectance data.

**A87-30896**

**REMOTE SENSING OF STRUCTURALLY COMPLEX SEMI-NATURAL VEGETATION - AN EXAMPLE FROM HEATHLAND**


Microcomputer-assisted video image analysis (VIA) was used to measure lodging in winter wheat, a symptom of foot rot disease. The percent area infested in the winter wheat in seven fields was measured from 35-mm true color and color-infrared aerial photos and from manually prepared photointerpretations made onto frosted Mylar sheet. Lodged wheat areas measured from these standard images ranged from 0.5 to 7.6 ha per field. Measurements made directly from photos consistently underestimated lodging by 0.2 to 2.4 ha per field relative to measurements from the standard images. Manual measurement of foot rot symptoms and grain yield in the seven fields showed 9 percent more severe lesions, and grain yield reductions of 1389 to 3416 kg/ha, in lodged wheat relative to erect wheat. Yield measurements combined with VIA lodging measurements made from the standard images showed the lodging-foot rot complex reduced yields by 136 to 796 kg/ha per field.

**A87-30897**

**SPECTRAL SEPARATION OF MOORLAND VEGETATION IN AIRBORNE THEMATIC MAPPER DATA**


Simulated Thematic Mapper (TM) data are examined for an area of the North Yorks Moors, northern England. The aim of analysis is to determine the number and identity of wavebands needed to distinguish specific moorland vegetation types from the surrounding community. The interband correlation and dimensionality of the data are found to be different for each of the vegetation types studied. Calculation of the transformed divergence measure shows that the major communities of bracken, heather and sedges are clearly separated with the use of one or two wavebands; four or five bands are needed to distinguish the stages of heather growth. In all cases, the combination of wavebands which maximizes discrimination is specific to the vegetation types.
to be separated. The work has practical implications for the use of TM data in the monitoring of the moorland landscape. Author

A87-30898
AIRBORNE MSS DATA TO ESTIMATE GLAI
(Contract NERC-GR/3/5096)

The use of airborne multispectral scanner data collected in June 1984 to estimate the green leaf area index (GLAI) for 60 sq km of grassland in England is examined. The processing of the data involves: (1) radiometric and atmospheric correction, (2) production of a vegetation index image, (3) calculation of a calibration relationship between a vegetation index and GLAI, (4) production of an image of estimated GLAI, and (5) accuracy assessment. The application of six refinements to this methodology is discussed. The effects of these refinements on the ability of the MSS data to accurately estimate the GLAI are investigated. It is observed that the refined methodology increased the GLAI estimation accuracy to + or - 0.09 GLAI for an area, and 60-82 percent at the 95 percent confidence level for a five-class classification. The repeatability of this refined methodology when using a different data set is evaluated. I.F.

N87-15507* Instiut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

MAPPING OF AGRICULTURAL LANDS IN THE USSR
ANATOLY I. PANFILOVICH In its Contributions to Geodesy, Photogrammetry, and Cartography, Series 2, No. 44 p 101-104 1986
Avail: NTIS HC A10/MF A01

Development of cadastral data acquisition through the inclusion of remote sensing methods, and development of cartographic methods of representation and analysis are described. Mathematical models for the investigation of national land resources and their evaluation in the context of the decision-making process are considered. Creation of a land resources data base with corresponding retrieval system for the entire national territory is discussed. Improvement of the integration of data acquisition, processing, and distribution as well as of the organization of land exploration at the national level is treated. ESA

N87-15514* Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

MICHAEL F. JASINSKI and PETER S. EAGLESON Nov. 1986 64 p
(Contract NAG5-510)
(NASA-CR-177077; NAS 1.26:177077) Avail: NTIS HC A04/MF A01 CSCL 02C

The present report summarizes the various approaches relevant to estimating canopy cover at subpixel resolution. The approaches are based on the analysis of radiometric models of transfer in non-homogeneous canopies and on empirical methods. The effects of vegetation shadows and topography are examined. Simplified versions of the model are tested, using the Taos, New Mexico Study Area database. Emphasis has been placed on using relatively simple models requiring only one or two bands. Although most methods require some degree of ground truth, a two-band method is investigated whereby the percent cover can be estimated without ground truth by examining the limits of the data space. Future work is proposed which will incorporate additional surface parameters into the canopy cover algorithm, such as topography, leaf area, or shadows. The model involves deriving a probability density function for the percent canopy cover based on the joint probability density function of the observed radiances. M.G.

N87-15517* South Dakota State Univ., Brookings.

MODELING ENERGY FLOW AND NUTRIENT CYCLING IN NATURAL SEMIARID GRASSLAND ECOSYSTEMS WITH THE AID OF THEMATIC MAPPER DATA Semiannual Progress Report
JAMES K. LEWIS 1987 16 p Original contains color illustrations
(Contract NAS8-28766)
(NASA-CR-179903; NAS 1.26:179903; SAPR-2) Avail: NTIS HC A02/MF A01 CSCL 13B

Energy flow and nutrient cycling were modeled as affected by herbivory on selected intensive sites along gradients of precipitation and soils, validating the model output by monitoring selected parameters with data derived from the Thematic Mapper (TM). Herbivore production was modeled along the gradient of soils and herbivory, and validated with data derived from TM in a spatial data base. B.G.

N87-15518* California Univ., Santa Barbara. Dept. of Geography.

CANOPY REFLECTANCE MODELING IN A TROPICAL WOODED GRASSLAND Final Report
DAVID SIMONETT and JANET FRANKLIN 1986 64 p
(Contract NAGW-788)
(NASA-CR-180097; NAS 1.26:180097) Avail: NTIS HC A04/MF A01 CSCL 02F

Geometric/ optical canopy reflectance modeling and spatial/ spectral pattern recognition is used to study the form and structure of savanna in West Africa. An invertible plant canopy reflectance model is tested for its ability to estimate the amount of woody vegetation from remotely sensed data in areas of sparsely wooded grassland. Dry woodlands and wooded grasslands, commonly referred to as savannas, are important ecologically and economically in Africa, and cover approximately forty percent of the continent by some estimates. The Sahel and Sudan savannas make up the important and sensitive transition zone between the tropical forests and the arid Sahara region. The depletion of woody cover, used for fodder and fuel in these regions, has become a very severe problem for the people living there. LANDSAT Thematic Mapper (TM) data is used to stratify woodland and wooded grassland into areas of relatively homogeneous canopy cover, and then an invertible forest canopy reflectance model is applied to estimate directly the height and spacing of the trees in the stands. Because height and spacing are proportional to biomass in some cases, a successful application of the segmentation/ modeling techniques will allow direct estimation of tree biomass, as well as cover density, over significant areas of the savannas and sensitive ecosystems. The model being tested in sites in two different bioclimatic zones in Mali, West Africa, will be used for testing the canopy model. Sudanian zone crop/woodland test sites were located in the Region of Segou, Mali.

N87-15519* Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Dept. de Sensoriamento Remoto.

THE USE OF AERIAL REMOTE SENSING IN A CASE STUDY OF DESERTIFICATION: QUIXABA-PE [O USO DE SENSORIAMENTO REMOTO AEREO PARA UM ESTUDO DE CASO DE DESERTIFICACAO: QUIXABA-PE]
VITOR CELSO DECARVALHO Jul. 1986 19 p In PORTUGUESE Presented at the 1st National Meeting of the Middle Atmosphere Study, Garanhuns, Brazil, 6-11 Oct. 1986 (INPE-3963-PRE/980) Avail: NTIS HC A02/MF A01

The Brazilian semiarid northeast, pointed out as one of the problem regions of the land, is presented, as a consequence of its fragile environment and high risk of desertification. A case of vegetative development in one of the problem sectors, a region of 'Quixaba', between the cities of Quiriacuri and Paramirim-PE, is found and analyzed qualitatively by interpretation of multi-seasonal area photographs (during 1955, 1965, and 1983). The results show an increase and notable agrarian shift in the region, but no change in the process of rapid degradation of its land. The situation at present is alarming, with almost 15% of its land now unproductive through human or natural action. Author
MODELIZATION OF EVAPOTRANSPIRATION AND SOIL
AVAILABLE WATER OVER AN AGRICULTURAL REGION
APPLICATION FOR REMOTE SENSING
O. TACONET In ESA Proceedings of an International Satellite
Land-Surface Climatology Project (ISLSCP) Conference p 65-71
May 1986
Avail: NTIS HC A99/MF A01
It is shown that in evaluating evapotranspiration over an
agricultural region, serious errors can arise by neglecting the
influence of vegetation. Using Dardorff's formalism (1978), the
single midday temperature is sufficient over dense canopies for
obtaining the bulk canopy resistance to evaporation, from which
the surface fluxes are derived. The two methodologies (with and
without vegetation) are tested by examining the evolution of
simulated fluxes (using NOAA-7 images) and the measured surface
fluxes during a 10 day period of soil drying. Surface heat flux is
effectively captured by the inversion method using measured
radiative temperatures and a vegetation parameterization. The
inversion methodology with bare soil formalism reveals inferior
performance, especially for greater sensitive heat flux, when applied
to a wheat canopy. However, while the agreement between
measured and modeled sensible heat fluxes support the vegetation
formalism, more field measurements are needed in order to
determine if this modeling is valid for different situations and
crops.

EVALUATION OF CLIMATE RELEVANT LAND SURFACE
CHARACTERISTICS FROM REMOTE SENSING
G. ESSER and H. LIETH In ESA Proceedings of an International
Satellite Land-Surface Climatology Project (ISLSCP) Conference p 205-211
May 1986
Avail: NTIS HC A99/MF A01
Land surface characteristics visual evaluation methods in
remote sensing are investigated. Discrimination of vegetation
formations and anthropogenically influenced communities is
discussed. Land use changes in South America were evaluated,
showing a mean annual increase of cleared areas of 9500 sq km.

SATELLITE-DERIVED VEGETATION INDEX OVER EUROPE
KLIAmmc BLEUMEL and W. TONN In ESA Proceedings of an
International Satellite Land-Surface Climatology Project (ISLSCP) Conference p 281-295
May 1986 Original contains color illustrations
Avail: NTIS HC A99/MF A01
Data from NOAA-AVHRR were used for deriving vegetation
indices. Indices depend on atmospheric influences, viewing
gometry, surface topography, and vegetation density. Results for
the most significant indices are presented. Bi-dimensional
histograms of spectral channel are performed in different regions
of Central Europe and North Africa for vegetation type analysis.

VEGETATION INDEX MODELS FOR THE ASSESSMENT OF
VEGETATION IN MARGINAL AREAS
R. HARRIS In ESA Proceedings of an International Satellite
Land-Surface Climatology Project (ISLSCP) Conference p 287-291
May 1986 Sponsored by Durham Univ.'s Middle East Center,
England
Avail: NTIS HC A99/MF A01
Ground radiometer data and LANDSAT thematic mapper data for
four terrain types in the Sidi Ali ben Aoun region of central
Tunisia are analyzed. The effects of the band ratio and the
normalized difference vegetation index on the near infrared/red
feature space are shown. The results show the sensitivity of the
vegetation indices to the data distribution.

NEW ZEALAND METEOROLOGICAL SERVICE, WELLINGTON.
CALIBRATION OF NORMALIZED VEGETATION INDEX
AGAINST PASTURE GROWTH
B. F. TAYLOR, P. W. DINI, and J. W. KIDSON In ESA Proceedings of
an International Satellite Land-Surface Climatology Project
(ISLSCP) Conference p 293-297 May 1986 Original contains color illustrations
Avail: NTIS HC A99/MF A01
The normalized vegetation index (NDVI) was calculated from
direct-readout NOAA-7 data for a pastoral farming area of New
Zealand. The correlation between monthly-mean NDVI and monthly
pasture growth, averaged over 7 measurement sites, is 0.8. Variations in NDVI on time scales < 1 month agree qualitatively
with estimates of regional daily rainfall and soil moisture. Results
suggest that routine monitoring of pasture growth by meteorological
satellites may be valuable to the agricultural industry.

CONTRIBUTION OF PASSIVE MICROWAVE REMOTE SENSING
IN SOIL MOISTURE AND EVAPOTRANSPIRATION
MEASUREMENTS
P. PAMPALONI, S. PALOSCIA, and L. CHIARANTINI (Segnalamento Marittimo ed Aereo S.p.A., Florence, Italy) in
ESA Proceedings of an International Satellite Land-Surface Climatology Project (ISLSCP) Conference p 327-332
May 1986
Avail: NTIS HC A99/MF A01
Microwave and infrared measurements (at 3 and 0.8 cm
wavelengths) on bare and vegetated soils are reported. Results
suggest that the 0.8 cm polarization index is related to leaf water
potential. The absorption properties of corn and alfalfa, computed
by means of the measured brightness temperature and a model
based on the radiative transfer theory, are correlated to plant
water content.
perceptions of the course of desertification create a need for an objective instrument for land degradation monitoring. The results imply a high potential to develop an operational satellite based system for productivity and drought impact monitoring and possibly for crop yield and drought impact prediction.

N87-15605# Calabar Univ. (Nigeria). Dept. of Geography and Regional Planning.

REGIONAL STUDIES WITH SATELLITE DATA IN AFRICA ON THE DESERTIFICATION OF THE SUDAN-SAHEL BELT IN NIGERIA


Airborne side-looking radar and LANDSAT data were used to monitor vegetation in the Sudan-Sahelian region (SSR). Results show that because of its balance of payments deficit, the SSR continues to put too much pressure on the land, encouraging desertification. Nigeria was classified as a member of the SSR after appraisal of the events sequel to the 1969 to 73 drought showed evidence of desertification in the West African sub-region. Desertification is now threatening areas north of latitude 10 N in the country. (ESA)

N87-15607# Kenya Meteorological Dept., Nairobi.

USE OF REMOTE SENSING APPLICATION FOR AGRICULTURAL EXPANSION INTO SEMI-ARID AREAS OF KENYA


Vegetation identification and variability in the Sahara region. The potential of LANDSAT-MSS to map vegetation in the Sudan-Sahelian region (SSR). Results show that because of its balance of payments deficit, the SSR continues to put too much pressure on the land, encouraging desertification. Nigeria was classified as a member of the SSR after appraisal of the events sequel to the 1969 to 73 drought showed evidence of desertification. Desertification is now threatening areas north of latitude 10 N in the country. (ESA)

N87-15610# Innsbruck Univ. (Austria). Inst. of Meteorology and Geophysics.

VEGETATION IDENTIFICATION AND VARIABILITY IN THE TAHOUA AREA, NIGERIA


Seven LANDSAT images were analyzed for vegetation cover and strength. The data were homogenized using unchanging test areas for normalization of vegetation index (NDVI) algorithm was applied. Vegetation changes are quantified in terms of the area covered by vegetation of specific NDVI and 600/700 nm reflectance. The MSS-S signal was used in addition to the NDVI to discriminate sparse vegetation from soil with increasing reflectance in the near infrared. The vegetation pattern provides information about soil moisture distributions. In dry years or seasons, vegetation concentrates in areas which carry open water during rainy seasons. The high resolution information clearly supplements global vegetation index maps. (ESA)

N87-15612# Ghent Univ. (Belgium). Lab. for Regional Geography.

ASSESSMENT OF WIND AND FLUVIAL ACTION BY USING LANDSAT-MSS COLOR COMPOSITES IN THE LOWER NILE VALLEY (EGYPT)


Black and white LANDSAT images were used to study wind and water erosion in the Nile Valley (Egypt). Wind action, especially upon the Western Desert, causes the erosion of the limestone plateau and is responsible for the accumulation of eolian deposits along the western boundaries of the Nile Valley. Fluvial action, by occasional thunderstorms, causes the erosion of the Eastern Desert plateau and hills and causes the accumulation of debris in the eastern side of the Nile valley. The Diaochochrome-film sandwich technique was used to get false color composites with an optimal contrast. The interference zone between the eolian deposits of the Western Desert and fluvial deposits of the Nile Valley is well recognized. (ESA)

N87-15614# Kasetsart Univ., Bangkok (Thailand). Faculty of Forestry.

THE APPLICATION OF LANDSAT IMAGERY FOR LAND COVER ASSESSMENT


Satellite imagery was used to study deforestation in Thailand. The forest land cover of the northeastern region in 1973 was 50,671 sq km (50%), decreased to 31,221 sq km (18.49%) in 1978, and to 25,886 sq km (15.33%) in 1982. The average forest land depletion in the period 1973 to 1978 is 8.4% annually, while the most critical locations are at Phan and Chi watersheds, at 10.85% and 10.21% per annum respectively. In the period 1978/1982, the average forest land depletion is 6.95% annually; the most critical locations are at Chi and Phan, at 8.56% and 8.16% per annum respectively. It is proved that LANDSAT imagery in term of black and white, and false color composite prints of 1: 250,000 scale can provide enough information on forest land cover and other land uses. (ESA)

N87-15615# Lund Univ. (Sweden). Lab. of Remote Sensing.

SURFACE ALBEDO CHANGE IN ARID REGIONS IN THE SUDAN


Albedo change for 8 regions in arid to semiarid zones in central Sudan was calculated using LANDSAT 1 and 3 images registered in Oct./Nov. 1972 and Oct. 1979. Increases in albedo intensities show a decrease in surface albedo indicating a better green biomass cover at the end of the rainy season in 1979 than in 1972. Increases in albedo occur in areas with high cultivation intensities. (ESA)

N87-15618# Zurich Univ. (Switzerland). Dept. of Geography.

MONITORING OF LAND-SURFACE CHANGE IN SRI LANKA


A method to continuously monitor land transformation processes and land-cover changes by satellite technology in Sri Lanka was developed. Land-use maps 1:100,000 (benchmark maps) and masking techniques form the basis for qualifying and quantifying the seasonal variations and long-term modifications results show worrying rates of deforestation and tea plantation disappearance. Paddy land remains constant. Data on other land use categories is insufficient. The Center for Remote Sensing at the Survey Department is executing the mapping and monitoring procedure and serves as focal point for introducing techniques and transferring results to the users, e.g., government agencies engaged in planning, resources management, and development. (ESA)
Evidence that surface climatology is changing in many parts of the Caribbean region is discussed. The trend is from humid tropical and dry seasonal forest towards increasing aridity, with savanization and actual desertification becoming apparent. There is a debate as to the degree to which the changes are anthropogenic and due to misuse of the environment. All evidence points to overexploitation of essentially fragile island ecosystems. Field studies and sampling of time-sequential satellite imagery, including LANDSAT, suggest that a combination of remotely sensed and ground verified data is useful in documenting trends in land surface climatology.  

**N87-156219**  
University of the West Indies, Kingston (Jamaica).  
VEGETATION CHANGE AND DESERTIFICATION IN THE CARIBBEAN  
L. ALAN EYRE  
In ESA Proceedings of an International Satellite Land-Surface Climatology Project (ISLSCP) Conference p 509-514  
May 1986  
Avail: NTIS HC A99/MF A01

Evidence that surface climatology is changing in many parts of the Caribbean region is discussed. The trend is from humid tropical and dry seasonal forest towards increasing aridity, with savanization and actual desertification being apparent. There is a debate as to the degree to which the changes are anthropogenic and due to misuse of the environment. All evidence points to overexploitation of essentially fragile island ecosystems. Field studies and sampling of time-sequential satellite imagery, including LANDSAT, suggest that a combination of remotely sensed and ground verified data is useful in documenting trends in land surface climatology.  

**N87-156219**  
National Aeronautics and Space Administration.  
THE FIRST INTERNATIONAL SATELLITE LAND SURFACE CLIMATOLOGY PROJECT (ISLSCP) FIELD EXPERIMENT - FIFE  
T. J. SCHMUGGE and J. M. SELLERS  
In ESA Proceedings of an International Satellite Land-Surface Climatology Project (ISLSCP) Conference p 567-571  
May 1986  
Avail: NTIS HC A99/MF A01 CSCL 06

The International Satellite Land Surface Climatology Project (ISLSCP) will verify the use of satellite data for the estimation of land-surface properties through field experiments using point measurements on the ground and areal measurements from aircraft overflights. It will study approaches for obtaining areal averages of the radiation, moisture, and heat fluxes made using remotely sensed data, by combining the surface point measurements of the fluxes with the aircraft areal observations using a surface energy balance model. Surface parameters to be estimated from aircraft observations include: surface radiation temperature, albedo, land cover or vegetation index, and surface soil moisture. The latter will be obtained using passive and active microwave approaches. The area-averages of the surface properties will be compared with satellite data. The First ISLSCP Field Experiment is planned for a site having relatively uniform vegetation cover in the central great plains of the U.S.A.  

**N87-171229**  
National Aeronautics and Space Administration.  
Earth Resources Lab., Bay St. Louis, Miss.  
MONITORING VEGETATION RECOVERY PATTERNS ON MOUNT ST. HELENS USING THERMAL INFRARED MULTISPECTRAL DATA  
KENNETH J. LANGRAN  
In JPL, California Inst. of Technology The TIMS Data User's Workshop p 53-54  
1 Nov. 1986  
Previously announced in IAA as A86-46106  
Avail: NTIS HC A05/MF A01 CSCL 02C

The Mount St. Helens 1980 eruption offers an opportunity to study vegetation recovery rates and patterns in a perturbed ecosystem. The eruptions of Mount St. Helens created new surfaces by stripping and impaling large volumes of eroded material and depositing tephra in the blast area and on the flanks of the mountain. Areas of major disturbance are those in the blast zone that were subject to debris avalanche, pyroclastic flows, mudflows, and blowdown and scorched timber, and those outside the blast zone that received extensive tephra deposits. It was observed that during maximum daytime solar heating, surface temperatures of vegetated areas are cooler than surrounding nonvegetated areas, and that surface temperature varies with percent vegetation cover. A method of measuring the relationship between effective radiant temperature (ERT) and percent vegetation cover in the thermal infrared (8 to 12 microns) region of the electromagnetic spectrum was investigated.  

**N87-171239**  
National Aeronautics and Space Administration.  
Earth Resources Lab., Bay St. Louis, Miss.  
INVESTIGATION OF FOREST CANOPY TEMPERATURES RECORDED BY THE THERMAL INFRARED MULTISPECTRAL SCANNER AT H. J. ANDREWS EXPERIMENTAL FOREST  
STEVEN A. SADER  
In JPL, California Inst. of Technology The TIMS Data User's Workshop p 55-57  
1 Nov. 1986  
Avail: NTIS HC A05/MF A01 CSCL 02

Thermal Infrared Multispectral Scanner (TIMS) data were collected over the H. J. Andrews Experimental Forest in Western Oregon on July 29, 1983 at approximately 1:30 p.m., Pacific Standard Time. The relation of changes in canopy temperature to green leaf biomass levels in reforested clearcuts and old-growth forest was investigated. A digital data base was generated in order to isolate that portion of the thermal emission that could be
attributed to surface properties other than the vegetation biomass component. The TIMS appears to be capable of detecting subtle differences in ERT as related to canopy closure and green lead biomass, however calibration techniques are needed to correct for emissivity and atmospheric effects.

B.G.

N87-17124*# National Aeronautics and Space Administration. Earth Resources Lab., Bay St. Louis, Miss.
APPLICATIONS OF TIMS DATA IN AGRICULTURAL AREAS AND RELATED ATMOSPHERIC CONSIDERATIONS
Avail: NTIS HC A05/MF A01 CSCL 02C

While much of traditional remote sensing in agricultural research was limited to the visible and reflective infrared, advances in thermal infrared remote sensing technology are adding a dimension to digital image analysis of agricultural areas. The Thermal Infrared Multispectral Scanner (TIMS) an airborne sensor having six bands over the nominal 8.2 to 12.2 m range, offers the ability to calculate land surface emissivities unlike most previous singular broadband sensors. Preliminary findings on the utility of the TIMS for several agricultural applications and related atmospheric considerations are discussed. ...

Author

N87-17126*# Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources
TIMS DATA APPLICATIONS IN NEBRASKA
LLOYD QUEEN and GENE MURRAY In JPL, California Inst. of Technology The TIMS Data User's Workshop (date) p 60 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08B

A total of 172 flight-line miles of Thermal Infrared Multispectral Scanner (TIMS) data were acquired in the state of Nebraska; and an additional mission is planned for August of this year. Data collected by the scanner were generally applied to investigations in four general areas: hydrology, geology, soils, and vegetation analysis. Relative simple manipulations of these thermal-emitance data led to excellent classifications of vegetation communities established along topographic gradients in the Nebraska Sandhills. Similar procedures were used to study variations in soil parameters along those same routes. Proposed geologic applications include mapping of the surficial geology along a portion of the Platte River and the delineation of a segment of the Cambridge Arch, a structural feature in central Nebraska. ...

Author

THE APPLICATION OF REMOTELY SENSED DATA TO PEDOLOGIC AND GEOMORPHIC MAPPING ON ALLUVAL FAN AND PLAYA SURFACES IN SALINE VALLEY, CALIFORNIA
D. A. MILLER, G. W. PETERSEN, and A. B. KAHLE In JPL, California Inst. of Technology The TIMS Data User's Workshop p 61 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08G

And and semiarid regions yield excellent opportunities for the study of pedologic and geomorphic processes. The dominance of rock and soil exposure over vegetation not only provides the ground observer with observational possibilities but also affords good opportunities for measurement by aircraft and satellite remote sensor devices. Previous studies conducted in the area of pedologic and geomorphic mapping in arid regions with remotely sensed data have utilized information obtained in the visible to near-infrared portion of the spectrum. Thermal Infrared Multispectral Scanner (TIMS) and Thematic Mapping (TM) data collected in 1984 are being used in conjunction with maps compiled during a Bureau of Land Management (BLM) soil survey to aid in a detailed mapping of alluvial fan and playa surfaces within the valley. The results from this study may yield valuable information concerning the application of thermal data and thermal/visible data combinations to the problem of dating pedologic and geomorphic features in arid regions. ...

Author

APPLICATION OF THERMAL INFRARED MULTIBAND SCANNER (TIMS) DATA TO MAPPING OF PLUTONIC AND STRATIFIED ROCK AND ASSEMBLAGES IN ACCRETED TERRAINS OF THE NORTHERN SIERRA, CALIFORNIA
JAMES V. TARANIK, DAVID DAVIS, and MARCUS BORENGASSER In JPL, California Inst. of Technology The TIMS Data User's Workshop p 71-73 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08B

The Thermal Infrared Multispectral Scanner (TIMS) data were acquired over the Donner Pass area in California on September 12, 1985. The higher peaks in the area approach 9,200 feet in elevation, while the canyon of the north fork of the American River is only 3000 feet in elevation. The vegetation is dominated by conifers, although manzanita and other shrubs are present in areas where soils have developed. The data contain noise patterns which cut across scan lines diagonally. The TIMS data were analyzed using both photointerpretative and digital processing techniques. Preliminary image interpretation and field analysis confirmed that TIMS image data displays the chert units and silicic volcanics as bright red. The imagery appears to display zoning in the batholithic and hypabyssal intrusive rocks, although this was not field checked at this time. Rocks which appear to be more dioritic in composition appear purple on the imagery, while rocks more granitic in composition appear shades of red and pink. Areas that have more than 40% vegetative cover appear green on the imagery. ...

Author

N87-17156*# Purdue Univ., West Lafayette, Ind. Dept. of Forestry and Natural Resources.
ANALYSIS OF MULTIPLE INCIDENCE ANGLE SIR-B DATA FOR DETERMINING FOREST STAND CHARACTERISTICS
Avail: NTIS HC A10/MF A01 CSCL 02F

For the first time in the U.S. space program, digital synthetic aperture radar (SR) data were obtained from different incidence angles during Space Shuttle Mission 41-G. Shuttle Imaging Radar-B (SIR-B) data were obtained at incidence angles of 58 deg., 45 deg., and 28 deg., on October 9, 10, and 11, 1984, respectively, for a predominantly forested study area in northern Florida. Cloud-free LANDSAT Thematic Mapper (T.M.) data were obtained over the same area on October 12. The SIR-B data were processed and then digitally registered to the LANDSAT T.M. data by scientists at the Jet Propulsion Laboratory. This is the only known digitally registered SIR-B and T.M. data set for which the data were obtained nearly simultaneously. The data analysis of this information is discussed. ...

Author

N87-17160*# Michigan Univ., Ann Arbor
SIR-B MEASUREMENTS AND MODELING OF VEGETATION
FAWWAZ T. ULABY and M. CRAIG DOBSON In JPL The Second Spaceborne Imaging Radar Symposium p 191-200 1 Dec. 1986
Avail: NTIS HC A10/MF A01 CSCL 02C

A summary is presented of the results derived from analysis of SIR-B data takes over an agricultural test site in west central Illinois. The first part describes the procedure used to calibrate the SIR-B imagery, the second part pertains to the observed radar response to soil moisture content, and the last part examines the information derivable from multangle observations. ...

Author
Oberpfaffenhofen, West Germany

COMPARISON OF THEMATIC MAPPER (TM) AND SPOT SIMULATION DATA FOR AGRICULTURAL APPLICATIONS IN SOUTH WEST GERMANY


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Data sets of pixel-sizes of 10, 20, 30, 50, and 80m created from data of a LANDSAT Thematic Mapper (TM) simulation were used for a comparative analysis between TM and SPOT-data of the information content in agricultural and forestry applications. The discrimination of objects depending on pixel-size and spectral bands was investigated. The TM-bands together with the improved resolution brought strong improvements in the separation of vegetated and built-up areas as well as growth stages of vegetation in comparison to MSS. The TM is found to be well suited for application in areas with average field sizes of 1.5 ha. The information content of the SPOT-multiband data-set is found to not essentially differ from that of TM. The results of a classification of the SPOT-multiband data are slightly less accurate than those using the TM-data.

ESA

SPATIAL ANALYSIS OF THE DYNAMICS OF AN ECOSYSTEM BY MULTISTAGE REMOTE SENSING IN KENYA


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Satellite data, an aerial survey, and ground reference data were used as a database for the analysis of the carrying capacity and the desertification process in the Uaso Nyiro River Basin of Northern Kenya. The carrying capacity in terms of the population density of the semi-and Loroqhi Plateau is 7 P/sqkm. But there are 14.5 P/sqkm currently living there and the population is growing. Due to the desertification process, the vegetation to support the livestock decreased by 11% in the last 16 yr. In the arid river basin the calculated carrying capacity is 2 P/sqkm. If one assumes that this calculation is still up to date, then the area south of the river is overpopulated by 275%. The overpopulation in the area north of the river reaches 490%. Due to the desertification process and the shrinking grazing land, todays carrying capacity of the river basin is a mere 1 P/sqkm. The dangerous overpopulation points toward a human tragedy in the near future in the arid lands of Northern Kenya.

ESA

MULTISPECTRAL CLASSIFICATION OF MICROWAVE REMOTE SENSING IMAGES


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Methods for the automatic classification and discrimination of crops are described. Microwave images in bands X and C collected during the European SAR 580 campaign are used. One and two dimensional classification algorithms using Bayes rule or the block distance are analysed. The probability of correct classification for different crops is presented.

ESA

THE INFLUENCE OF RESAMPLING METHOD AND MULTITEMPORAL LANDSAT IMAGERY ON CROP CLASSIFICATION ACCURACY IN THE UNITED KINGDOM


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Six sequential LANDSAT MSS scenes for a test site were geometrically corrected. Resampling to 50m pixel size was carried out with bilinear interpolation and nearest neighbor. Spectral coincident plots and decision boundaries were used for feature selection, and supervised maximum likelihood classification used for crop classification. Bilinear interpolation gives a mean increase in classification accuracy of 1.95% over nearest neighbor. Multitemporal data give better overall classification accuracies than single date images. A spring/early summer combination gives a mean classification purity of 70%, a 6% increase over the best single date classification from May, and 46% better than the worst from February.

ESA

DIELECTRIC AND SURFACE PARAMETERS RELATED TO MICROWAVE SCATTERING AND EMISSION PROPERTIES


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A correlated study of the dielectric properties, surface roughness, and the backscatter and emission behavior of bare soil is presented. For the measurement of the permittivity of the soil field proof dielectric sensors at frequencies between 0.5 and 1 GHz were developed. A surface sensor measures the dielectric constant of a top 1 cm layer and a volume sensor averages over a depth of 15 cm. For the measurement of surface roughness, a laser distance measurement system was designed. It measures a 1 m long surface height profile. Quantities like distribution and standard deviation of heights and slopes, or the autocorrelation function are computed and used in scattering models. Temperature profiles, soil moisture, and texture are determined. Together with the soil parameters, the microwave signatures are measured with an L to X-band radiometer-scatterometer. Emissivities and backscattering coefficients are related to the soil parameters, and compared with model calculations.

ESA

EXTRACTION OF THE BACKSCATTER COEFFICIENT OF AGRICULTURAL FIELDS FROM AN AIRBORNE SAR IMAGE


Avail: ESA

RELATIVE and absolute calibration was performed on an X-band SAR image of an agricultural area. The image presented distortions due mainly to aircraft motions and to the antenna gain function. Distortions due to aircraft motions, resulting in dark rays perpendicular to the flight direction, are corrected by a spectral filtering method. The thermal noise is estimated and subtracted from the image. The antenna gain is evaluated by using a distributed target of a priori known angular variation. A correction taking into account the antenna gain and the range is applied to the image.
The scattering coefficient is estimated using a Luneberg lens located in the scene. Errors in this estimation are assessed.

MICROWAVE REMOTE SENSING: ITS APPLICATIONS AND LIMITATIONS IN OPERATIONAL TASKS OF LAND USE INVENTORY AND FOREST MANAGEMENT

Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+ 20% others)

Woodland and agricultural aspects of land use, based on experience with Seasat-SAR, SAR-580 and SIR-B imagery are reviewed. Potential applications and the limitations of microwave remote sensing sensors for operational tasks of land use inventory are described.

VIEWING ANGLE CORRECTIONS OF AIRBORNE MULTISPECTRAL SCANNER DATA ACQUIRED OVER FORESTED SURFACES

Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+ 20% others)

Airborne MSS BENDIX M2S Scanner data obtained over a forested area were analyzed in order to assess the viewing angle effect. All of the bands situated within 0.4 to 1.1 microns are affected by the viewing angle. The magnitude of this effect results in a gray level difference of up to 35% within a viewing angle range from 0 (nadir) to 40 deg. In order to remove this radiometric distortion due to off-nadir viewing, two correction procedures, the additive adjustment technique and different band transformations were applied to the image data. The additive adjustment technique gives the best result. Due to the viewing angle correction, a significant improvement of the classification accuracy is achieved.

AN OVERVIEW OF REMOTE SENSING AGRICULTURAL APLICATIONS IN NORTH AMERICA: PAST, PRESENT AND FUTURE

Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+ 20% others)

The use of remote sensing for crop condition monitoring and crop area determination is reviewed. The Large Area Crop Inventory Experiment and the AGRISTARS project are recalled. The LANDSAT and NOAA satellite instruments used in agricultural remote sensing are described.

APPLICATIONS OF REMOTE SENSING IN THE US DEPARTMENT OF AGRICULTURE

Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+ 20% others)

The U.S. Department of Agriculture uses remote sensing to monitor and assess crop conditions and to manage renewable resources. The Foreign Agriculture Service uses meteorological satellite data and LANDSAT data to monitor the status of crops in major agricultural regions of the world. The National Agricultural Statistics Service uses LANDSAT data to improve estimates of crop acreage in the central U.S. The Soil Conservation Service will use aircraft data to aid in the inventory of U.S. agricultural lands. Research to improve agency procedures is described.

ASSESSING GRASS CANOPY CONDITION AND GROWTH FROM COMBINED OPTICAL-MICROWAVE MEASUREMENTS

Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+ 20% others)

The potential of a combined optical-microwave sensor system for monitoring canopy condition and development in a natural tallgrass prairie was assessed. A set of linear classification functions was derived for distinguishing among tallgrass prairie surface cover types based on their spectral characteristics. An indirect procedure for estimating green leaf area index and phytomass for measurements of red and near infrared canopy reflectance was developed. Microwave (C-band) scatterometer measurements are found to strongly correlate with near-surface soil water content of the grassland.

ANALYSIS OF THE SPATIAL STRUCTURE OF SYNTHETIC APERTURE RADAR (SAR) IMAGERY FOR A BETTER SEPARABILITY OF CEREAL CROPS, WHEAT AND BARLEY

Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+ 20% others)

The analysis of the statistical characteristics of radar data for wheat and barley is discussed. The SAR data set is of good quality and comprises two depression angles, two row directions for each field, and three flight dates. A methodology of image processing which concerns the examination of structure and texture in image data is outlined. Results reveal two important characteristics in separating wheat from barley: the degree of homogeneity and the row effect. The texture analysis can be used to separate wheat and barley.

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01 AGRICULTURE AND FORESTRY

N87-17288#  Center National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
TOward a SATELLITE SYSTEM to MONITOR the SPATIAL and TEMPORAL BEHAVIOR of SOIL WATER CONTENT
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

It is shown that using proper simple parameterizations of the soil/vegetation/ atmosphere system it is possible to derive soil water content and surface atmospheric fluxes at satellite pixels scale. Though the algorithms must be further tested, it is anticipated that a future space system (geostationary satellites and polar platforms) using visible, thermal infrared, and microwave remote sensing may be used on an operational basis as a hydrologic observatory.

N87-17289#  California Univ., Berkeley. 260 Space Sciences Lab.
UTILITY OF REMOTE SENSING DATA in RENEWABLE RESOURCE SAMPLE SURVEY
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

It is shown how remote sensing technology offers possibilities for sample-based estimation of renewable resource means and totals. Studies show that significant improvements in estimate precision, cost, or timeliness are available for estimation of crop and irrigated area, forest wood volume and growth, and useable livestock forage when satellite data and/or aerial photography are included as sample stages. Land satellite data often provide a highly cost-effective, rapid alternative for stratifying a region into strata having a smaller range of variation in the ground parameters(s) of interest. Satellite and aircraft data can provide sample unit-specific measurements, correlated to corresponding ground measurements, reducing required ground sample size and inventory time.

N87-17304#  Texas Instruments, Inc., Dallas.
THE EFFECT of MEASUREMENT ERROR and CONfusion FROM VEGETATION on PASSIVE MICROWAVE ESTIMATES of SOIL MOISTURE
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The sensitivity of error in soil moisture estimates to passive microwave measurement error as a function of vegetation was studied using a simple model and measurements. Roughness confusion is not considered. The direct problem is defined as investigating the sensor response as the dependent variable to the parameter of interest while the inverse problem uses the parameter of interest as the dependent variable. The inverse method must be used for operational remote sensing applications. It is shown that this difference becomes very important when both confusion and measurement error are considered. A methodology whereby the sensitivity to measurement error attributed to vegetation can be estimated from the perpendicular vegetation index is presented.

N87-17305#  Helsinki Univ. of Technology, Espoo (Finland). Radio Lab.
CLASSIFICATION OF FOREST and SURFACE TYPES by SATELLITE MICROWAVE RADIOMETRY
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Scanning Multichannel Microwave Radiometer 10-GHz and 18-GHz data from Nimbus-7 were employed to investigate the classification of forest and surface types. Data for Falls 1978 and 1979 were compared against a digital map that shows 7 different forest and surface types for Southern Finland. The results indicate that four different categories can be discriminated: pine-dominant forest, other forest types (spruce-dominant and deciduous) and bogs, farmland, and water.

N87-17313#  INTERA Environmental Consultants Ltd., Ottawa (Ontario).
SAR IMAGERY for FOREST MANAGEMENT
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A high resolution, digital, airborne, HH polarized, X-band SAR was tested for forest management. The SAR was compared with conventional panchromatic aerial photography in terms of information content, costs and timing. SAR data suggests that conventional imagery and SAR can provide information that would be difficult to obtain by traditional means. A LANDSAT based snow cover recession map is found to be a fundamental variable influencing a number of layers within the ecological data set. It is shown quantitatively, for example, how snow cover recession and floral associations are related. This assists in vegetation mapping and can be used to simulate vegetation.

N87-17316#  Zurich Univ. (Switzerland). Dept. of Geography.
SNOW COVER RECESSION in AN ALPINE ECOLOGICAL SYSTEM
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

In the Man and Biosphere project, an ecological survey in a high Alpine valley was carried out. Data from climatology, forestry, game biology, land use history, pedology, and vegetation were assembled into a Geographic Information System. A LANDSAT based snow cover recession map is found to be a fundamental variable influencing a number of layers within the ecological data set. It is shown quantitatively, for example, how snow cover recession and floral associations are related. This assists in vegetation mapping and can be used to simulate vegetation.
EVALUATING ROUGHNESS MODELS OF RADAR BACKSCATTER


Three radar backscatter roughness models were assessed using soil moisture data collected by the Space Shuttle flight 41G SIR-B SAR in an intensively farmed area. The SIR-B data swath included a large number of bare, dry fields with a large variety of surface roughnesses. The small perturbation model gives the best results, particularly when fields with a definite periodic row structure were omitted. The standard deviation of surface heights appears to be a good measure of relative roughness conditions, but the correlation length is not a good descriptor of the surface, and does not seem to be related in any way to the measured backscatter.

BACKSCATTER EVALUATING ROUGHNESS MODELS OF RADAR BACKSCATTER


A broadband H and V polarization radiometer was combined with a noise transmitter to an instrument for measuring active and passive microwave signatures at seven frequencies between L and X band. This radiometer-scatterometer is operated from a cherry picker over agricultural fields. During the growing seasons the development of sugar-beet, wheat, and corn was measured. The geometrical structure of the vegetation cover was described by recording the crop type, the distances between the plants, and the canopy height. The soil underneath was characterized by moisture, temperature profile, and dielectric constant. Another variable was the seasonal change in water content of the plants. Forestry, rice cultivation, and drainage networks were mapped and the results compared with data from LANDSAT-5 TM data was studied as a source of information for land and water resources (inventories). Two false color composite images, scale 1:250,000, were used as the data source. Forestry, rice cultivation, and drainage networks were mapped and the results compared with data from published 1:250,000 topographic maps. The results show that LANDSAT provides an acceptable degree of accuracy to permit first order mapping of surface drainage, forestry, and rice fields in Iran, where there is an acute shortage of information relating to the land and water resources.

CROP IDENTIFIER CANOPY HOT-SPOT AS CROP IDENTIFIER


Illuminating any reflective rough or structured surface by a directional light source results in an angular reflectance distribution that shows a narrow peak in the direction of retro-reflection. This is called the Heiligeschein or hot-spot of vegetation canopies and is caused by mutual shading of leaves. The angular intensity distribution of the hot-spot, its brightness and slope, are therefore indicators of the plant's geometry. We propose the use of hot-spot characteristics as crop identifiers in satellite remote sensing because the canopy hot-spot carries information about plant stand architecture that is more distinctive for different plant species than, for instance, their spectral reflectance characteristics. A simple three-dimensional Monte Carlo/ ray tracing model and an analytic two-dimensional model are developed to estimate the angular distribution of the hot-spot as a function of the size of the plant leaves. The results show that the brightness-distribution and slope of the hot-spot change distinctively for different leaf sizes indicating a much more peaked maximum for the smaller leaves.
THERMAL INERTIA AND SOIL FLUXES BY REMOTE SENSING

The diurnal surface temperature cycle is shown to be insensitive to the initial temperature profile and the lower boundary conditions, allowing the soil to be treated with an analytic steady state model as a transmission line problem. It is possible to calculate the soil conducting flux directly from the satellite temperature data, without the knowledge of the energy exchange process at the ground surface, provided that the soil thermal inertia is known. A simple inverse model can then be derived to calculate the soil thermal inertia and soil fluxes using visible and infrared satellite data along with standard meteorological data. The model requires neither the linearization of the flux terms at the ground surface nor the knowledge of the lower boundary condition and the soil initial temperature profile. The model, applied to a lake, yields an error less than 4% in the estimate of thermal inertia and sensible heat flux. The model can be extended to generate thermal inertia and heat flux maps without any in-situ measurements.

SOIL HAZARDS OF HARYANA STATE, INDIA

The use of aerial photographs and LANDSAT images to help devise cost-effective methods to stabilize erosion features in the Kocaeli peninsula (Turkey) is discussed. The basic maps, such as detailed erosion and land use maps, must immediately be produced using remote sensing techniques. Critical areas having serious erosion problems in terms of producing water have to be designated using the maps in order to decide cost-effective treatment methods. If the erosion control works are carried out using the small scale maps produced by conventional ground surveys, control works may be expensive and may not achieve the expected conservation objectives.

APPLICATION OF REMOTE SENSING IN THE STUDY OF THE SOIL HAZARDS OF HARYANA STATE, INDIA

Multispectral and multitemporal LANDSAT images of Haryana state (India) and of representative areas were interpreted to delineate the soil hazards and normal soils. The major soil hazards of different intensity levels identified are saline-alkali soils, wind erosion, water erosion, river deposition, and water-logging. The soil associations at great group level are Udipsamments, Torripsamments, Ustorthents, Ustifluvents, Ustipsamments, Torripsamments, Ustorthents, Ustifluvariants, Ustochrepts, Hapluepts, Calcorthids, Camborthids, Ochorquails and Natrustrips. A map depicting intensity and distribution of soil hazards in Haryana state was prepared.
AN INTEGRATED DATA BANK FOR AGRICULTURAL PRODUCTIVITY BY REMOTE SENSING

C. CONESE, L. BACCI, G. MARACCHI, V. CAPPELLINI, and R. CARLA


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A methodology for the assessment and evaluation of natural resources in order to establish the land actual and potential agricultural productivity is proposed. The main sources of information are conventional cartography, LANDSAT TM image processing, NOAA and Meteosat satellite image processing, soil cartography, meteorological data, and models of main crop productivity. The integrated information obtained from these different sources are used to simulate crop productivity and build up a map of land capacity.

MARRYING GEOCODED IMAGE DATA WITH OTHER TYPES OF GEOGRAPHIC INFORMATION IN A PC ENVIRONMENT

S. ZENKER, A. ENGBERG, G. GRAPE, and H. MALMSTROEM


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The power of interactive analysis of geographic data on an IBM-AT image processing system was demonstrated in a forestry application. By pointing with a cursor within a LANDSAT TM image on the screen, associated timber stand boundaries and ancillary data are immediately displayed.

INTEGRATING VECTOR AND SATELLITE DATA TO EVALUATE THE ADEQUACY OF A GRAIN SILO NETWORK

E. J. VANVUUREN, P. A. J. VANRENSBURG, and S. H. VONSOLMS


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A computerized method for preparing vector type geocoded geographical data to be overlaid on to a LANDSAT 4 MSS image is described. The geographical data sets consisted of silo range boundaries digitized from 1:250 000 maps, and soil potential contours generated by computer-aided modeling procedures. These geocoded geographical data were initially line segments represented by their coordinates. After rasterizing the geocoded data sets, they were overlayed on to classification maps generated from the LANDSAT data to calculate potential grain production per silo range.


INFLUENCE OF CANOPY SHADOW ON STRESS DETECTION IN CONIFEROUS FORESTS USING LANDSAT DATA

C. BANNINGER


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The effects of canopy shadow decreasing the spectral response of stressed canopies in the visible and shortwave near-infrared, contrary to what is expected in these spectral regions, on stress detection of coniferous forests by remote sensing systems are discussed. If a reduction in leaf pigment and water content also takes place, one would expect to see an increase in canopy reflectance in the visible and shortwave infrared LANDSAT bands, due to an increase in leaf transmittance and reflectance and a corresponding decrease in canopy shadow. This does not appear to happen, at least not in a sufficient amount to negate the increase in canopy shadow caused by morphological changes in the canopy.


RELATIONSHIP BETWEEN TREE DENSITY, LEAF AREA INDEX, SOIL METAL CONTENT, AND LANDSAT MSS RADIANCE VALUES

C. BANNINGER


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Measurements from a coniferous tree stand in soils containing high concentrations of copper, lead, and zinc of soil metal concentrations and tree density and stem diameter helped to establish relationships between canopy structure (stand density and leaf area index), soil metal content, and LANDSAT canopy radiance values. Canopy properties that most affect the spectral response of metal-stressed coniferous tree stands in LANDSAT scene data were defined. Results suggest that subtle or incipient levels of heavy metal stress in coniferous trees are most likely manifested by morphological rather than physiological changes in a canopy, and that these changes are capable of being detected by rather coarse spatial, spectral, and radiometric resolution sensor systems operating from space platforms, such as the LANDSAT Multispectral Scanner.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.

AMES RESEARCH CENTER, Moffett Field, Calif.

REMOTE SENSING OF WETLAND PLANT STRESS


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
01 AGRICULTURE AND FORESTRY

N87-18175* # Jet Propulsion Lab., California Inst. of Tech., Pasadena.
USE OF TMS/TM DATA FOR MAPPING OF FOREST DECLINE DAMAGE IN THE NORTHEASTERN UNITED STATES
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 02F
Remote sensing systems were used to monitor forest decline damage suspected of being due to air pollution. Field activities and aircraft overflights were centered on montane spruce/fir forest sites. Using aircraft data acquired with the Thematic Mapper Simulator (TMS) and LANDSAT Thematic Mapper (TM) during the growing season, extensive areas of forest decline damage were accurately mapped. Seven levels of decline damage are discriminated and mapped and the levels of discriminated damage agree well (rsq=0.94) with visual assessment conducted on the ground. New areas of high damage were discovered. A band ratio (TM5/TM4) is most useful in discriminating and quantifying the various levels of forest decline damage. ESA

OFF-NADIR OPTICAL REMOTE SENSING FROM SATELLITES FOR VEGETATION IDENTIFICATION
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
It is shown that angular reflectance distribution from vegetated surface in the visible and near infrared regimes contain angular signatures that may be used as crop identifiers. The canopy hot spot is such an angular signature and is invariant to atmospheric perturbations. It is proposed as a crop identifier from satellite observations. The value of angular signatures for scene identification is clearly established and considered complementary to the spectral signatures. Off-nadir satellite remote sensing of the Earth's land surface, which consists almost exclusively of non-Lambertian surfaces, may provide very valuable information for surface feature identification that is not otherwise attainable. The provision of directional pointing capabilities in future Earth observing satellites is thus highly desirable. ESA

N87-18184# Freiburg Univ. (West Germany). Inst. for Physical Geography.
MULTITEMPORAL ANALYSIS OF THE PHENOLOGICAL STAGE OF VEGETATION USING TM-DATA IN THE SOUTHERN BLACK FOREST (WEST GERMANY)
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
A multitemporal dataset of a mountainous watershed was created including elevation, slope and aspect, LANDSAT Thematic Mapper bands 3 and 4 of 2 scenes taken in April and July, and the solar irradiance for each point at the time and date of each overflight. Through modeling of the irradiance, slope and aspect influences due to different illuminations were eliminated and the ratio -vegetation-index (RVI) of selected grass plots of different elevation and aspect was calculated for the two dates. The RVI shows an exponential decline with elevation in April, whereas in July the RVI of the grass areas is almost constant throughout the watershed. This shows that the RVI, after proper correction of illumination differences, can be used as indicator for the phenological stage of grassland in mountainous terrain. ESA

N87-18185# Environmental Research Inst. of Michigan, Ann Arbor.
VEGETATION AND SOILS INFORMATION CONTAINED IN TRANSFORMED THEMATIC MAPPER DATA
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
The LANDSAT Thematic Mapper (TM) Tasseled Cap data transformation method for reorienting TM data such that vegetation and soil information can be more easily extracted, displayed, and understood is outlined. The transformation applied as to any temperate climate scene produces invariant features which can be directly compared (i.e., between scenes or sensors), thereby simplifying the development of automatic signal processing algorithms and minimizing the need for recalibration of either algorithms or expectations (i.e., of human interpreters). In the TM Tasseled Cap features space, information on vegetation type, stage of development, and condition, and soil type and moisture status, is readily available. Atmospheric condition can be estimated from the data themselves, with minimal impact from ground class response differences. ESA

N87-18186# Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. of Agricultural Engineering.
DESCRIPTION OF A NEW METHOD TO DETERMINE BIOMASS CHANGE MAPPING WITH THE USE OF LANDSAT TM DATA
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
A methodology to obtain a vegetation change index (VCI) computed from non calibrated radiometric data in the red and near infrared bands is proposed. Perpendicular vegetation indices for two dates are first normalized and then subtracted to produce a VCI. The whole procedure was developed for an interactive user-friendly use on an I25 image processing system. It is illustrated with the use of two Thematic Mapper bands on a region of western Switzerland.

N87-18187# Haryana Agricultural Univ., Hisar (India).
REMOTE SENSING APPLICATIONS IN THE STUDY OF LAND USE AND SOILS OF AEOLIAN COVER OF THE WESTERN PART OF HARYANA STATE, INDIA
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
Multispectral and multitemporal LANDSATS false color composites of 1:250,000, and transparencies on 1:1 million scales of bands 4,5, and 7 were interpreted to identify and delineate areas under varying intensities of dunal activity in the western part of Haryana state comprising an area of 12610 sq.km. Some CCTs of representative areas were also interpreted on the Multispectral Interactive Data Analysis System. Field checks were made to correlate the laboratory interpretation and the ground truth. The study area was differentiated into: sandy desert zone: no cultivation on dune tops except some shrubs; aeolian cover with sandy hummocks: low intensity cultivation; plain with aeolian cover: moderately cultivated; plain: moderately to intensively cultivated. ESA
and the spatial differences in reflectances between interpreted from changes in soil and the playas. Imagery has been used to absorbance between wet and been used to analyze changes in surface reflectance and playas in south-central Tunisia. Change detection images have been used to construct change detection images (NASA-CR-180181; NAS 1.26:180181) Avail: NTIS HC ANDREW C.

MONITORING SEDIMENT TRANSFER PROCESSES ON THE DESERT MARGIN

luftbildmessung und fernerkundung.

LASER-INDUCED CHLOROPHYLL-A FLUORESCENCE OF TERRITORIAL PLANTS

The processing of and information extraction from airborne SLAR data

FOREST COVER ANALYSIS USING SIR-B DATA

OF AGRICULTURE AND FORESTRY

multidate imagery are changes in surface moisture, texture and chemical composition, vegetation cover and the extent of aeolian activity. Inter-annual change phenomena are divisible into those restricted to marginal playa facies (sedimentation from sheetwash and alluvial fans, erosion from surface runoff and cliff retreat) and these are found in central playa facies which are related to the internal redistribution of water, salt and sediment. Author


LANDSAT Thematic Mapper and Multispectral Scanner data have been used to construct change detection images for three playas in south-central Tunisia. Change detection images have been used to analyze changes in surface reflectance and absorption between wet and dry season (intra-annual change) and between different years (inter-annual change). Change detection imagery has been used to examine geomorphological changes on the playas. Changes in geomorphological phenomena are interpreted from changes in soil and foliar moisture levels, differences in reflectances between different salt and sediments and the spatial expression of geomorphological features. Intra-annual change phenomena that can be detected from


THE PROCESSING OF AND INFORMATION EXTRACTION FROM AIRBORNE SLAR DATA


Side-looking airborne radar crop identification in The Netherlands is discussed. Only a selected number of crops may be unambiguously identified, and crop growth stages must be closely monitored in order to select optimal flight dates and acquisition geometry. In order to proceed to operational conditions it is necessary to include internal and external calibration of the radar to allow for cross-comparison of data. Although external targets (corner reflectors) were placed at a number of locations

N87-18192# Illinois Natural History Survey, Champaign. Section of Botany and Plant Ecology

INTERPRETING FOREST AND GRASSLAND BIOME PRODUCTIVITY UTILIZING NESTED SCALES OF IMAGE RESOLUTION AND BIOGEOGRAPHICAL ANALYSIS


NASA-CR-180213; TMWR-PR-3; NAS 1.26:180213; TS-BFP-1987-1) Avail: NTIS HC A03/MF A01 CSCL 05B

This report summarizes progress made in our investigation of forest productivity assessment using TM and other biogeographical data during the third six-month period of the grant. Data acquisition and methodology hurdles are largely complete. Four study areas for which the appropriate TM and ancillary data were available are currently being intensively analyzed. Significant relationships have been found on a site by site basis to suggest that forest productivity can be qualitatively assessed using TM band values and site characteristics. Perhaps the most promising results relate TM unsupervised classes to forest productivity, with enhancement from elevation data. During the final phases of the research, multi-temporal and regional comparisons of results will be addressed, as well as the predictability of forest productivity patterns over a large region using TM data and/or TM nested within AVHRR data. Author


OFF-NADIR OPTICAL REMOTE SENSING FROM SATELLITES FOR VEGETATION IDENTIFICATION

S. A. W. GERSTL 30 May 1986 5 p Presented at the IGARSS '86 Symposium, Zurich, Switzerland, 8 Sep. 1986 (Contract W-7405-ENG-36)

(DE86-012387; LA-UR-86-1927; CONF-860997-1) Avail: NTIS HC A02/MF A01

Today's satellite remote sensing systems rely heavily on spectral signatures for scene identification from nadir observations. We propose to use angular signatures as complementary scene identifiers when off-nadir sensing is possible. Specifically, the hot spot (Heiligenschein) of plant canopies is recognized as an atmosphere-invariant angular reflectance signature that carries information about the plant stand architecture which may be useful for instant crop identification from off-nadir satellite measurements.

DOE

N87-18207# Oldenburg Univ. (West Germany). Abteilung Luftbildmessung und Fernerkundung.

FOREST COVER ANALYSIS USING SIR-B DATA


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A modified oceanographic lidar system operating over forest regions detected the chlorophyll A fluorescence at 685 nm and 735 nm. Inspecting the fluorescence signal ratio along the flight lines confirms that the fluorescence ratio reflects the physiological state of the plant. Results correspond to the evaluation of multispectral scanner data and terrestrial investigation. ESA

N87-18220# Freiburg Univ. (West Germany). Abteilung Luftbildmessung und Fernerkundung.

MONITORING SEDIMENT TRANSFER PROCESSES ON THE DESERT MARGIN


LANDSAT Thematic Mapper and Multispectral Scanner data have been used to construct change detection images for three playas in south-central Tunisia. Change detection images have been used to analyze changes in surface reflectance and absorption between wet and dry season (intra-annual change) and between different years (inter-annual change). Change detection imagery has been used to examine geomorphological changes on the playas. Changes in geomorphological phenomena are interpreted from changes in soil and foliar moisture levels, differences in reflectances between different salt and sediments and the spatial expression of geomorphological features. Intra-annual change phenomena that can be detected from
throughout the test areas, consequences on processing and classification need further evaluation. It is argued that airborne programs will become largely obsolete due to the multitemporal and synoptic characteristics of spaceborne systems. 

N87-19786# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).


A statistical methodology is presented for estimating areas cultivated with several cultures using information gathered by the LANDSAT satellite, as well as ground data collected by trained enumerators. Paper strata constructed within analysis district are used to improve the precision of the desired estimates. Direct expansion estimators to be used over ground data and regression estimators combining the results of LANDSAT classification with survey data on those areas where these two sources of data are available are proposed.

Author

N87-19790# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).


The CANASATE Project, Sugarcane Mapping by Satellite, has the objective of obtaining the spatial distribution and area estimations of sugarcane plantations, at national level, using remote sensing techniques. To achieve this objective, Brazil was divided into three areas: Area 1, which includes Rio de Janeiro, Sao Paulo and Para states; Area 2, which includes Alagoas and Pernambuco states; and Area 3, which includes Minas Gerais, Espirito Santo, Goias and Mato Grosso do Sul states. The results are shown for Area 3, which represents approximately 7% of the national sugarcane plantations.

Author

N87-19797# Technische Hogeschool, Delft (Netherlands). Dept. of Electrical Engineering.


A pulse modulated radar obtained information about bare soils in agricultural fields. The radar signal was transmitted and received by the Delft University Scatterometer system in L-band. The corrections of the scatterometer data to obtain an accurate backscatter coefficient were performed by antenna measurements. The antenna radiation pattern and the maximal gain were determined. Ground truth measurements, together with scatterometer data (at different incidence angles) were gathered to test the inverse use of a scatter model for bare soil. With the help of video recordings (airborne) angular dependency of the radar backscatter and its possible relation with the measured soil moisture content and roughness was confirmed by the model of Attema, Kats, and Krul (1982).

ESA


Thematic mapping data was analyzed and verified by comparison to previously gathered transect samples and to aerial photographs. A bare-soil field with exposed paleosols characterized by slight enrichment of iron was investigated. Spectral relationships were first investigated statistically by creating a data set with DN values spatially matched as nearly as possible to field sample points. Chemical data for each point included organic carbon, free iron oxide, and amorphous iron content. The chemical data, DN values, and various band ratios were examined with the program package Statistix in order to find the combinations of reflectance data most likely to show a relationship which would dependably separate the exposed paleosols from the other soils. Cluster analysis and Fastclass classification procedures were applied to the most promising of the band ratio combinations.

B.G.

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.


An Old Delft Scanning Stereoscope with 4.5 times magnification, and 1:12,000 black-and-white panchromatic aerial photographs obtained on January 6, 1983, were used to estimate the population of Athens, Georgia. Land use and land cover checks were performed to identify residential structures and to establish a photointerpretation key which identified three dwelling types. Using population factors of 2, 3, and 4 per dwelling for multiunit, small single-family, and large single-family dwellings, respectively, comparison with population census data revealed a relative error of -1.74 percent, which was improved to +0.73 percent when the larger census tracts were used.

R.R.


The use of geographic information systems to generate land use data from satellite imagery is examined. Geographic information systems can be grid, raster, polygon, or vector based.
The procedures for developing a geographic reference system are described. Techniques for reducing the spectral and spatial resolution limitations of classified satellite maps and improving the ability of the maps to classify heterogeneous areas are discussed.

A87-23629
DETECTION OF NEW URBAN BUILD-UP IN ARDMORE AND MCALESTER, OKLAHOMA USING LANDSAT MSS DATA

A87-29007
PERFORMANCE OF LANDSAT-5 TM DATA IN LAND-COVER CLASSIFICATION

An experimental analysis has been conducted on the performance of the new Landsat-5 Thematic Mapper (TM) data for detailed land-cover classification using a maximum-likelihood method. Data used is the TM test data of the Tokyo metropolitan area (path-107, row-035) of November 4, 1984. Map-precision geometric correction is performed and TM data are resampled to 30 m pixel spacing. The experiment is designed to determine how well TM categories land-cover types in comparison with the Detailed Numerical Information digitally formatted data (Geographical Survey Institute of Japan, 10 m spatial accuracy), together with ground truth data in a representative test area. Classification accuracy for aggregated 12 categories within the test area is about 47 percent with the application of the explicit filtering technique utilizing 3 x 3 neighborhood operations. This increases to 70 percent using a majority logic filter with a larger 5 x 5 neighborhood function. Associated with the classification accuracy, effects of the mixed pixels are also investigated. The results show that the improved characteristics of TM aided the overall classification accuracy.

A87-30128*
National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.
USE OF TOPOGRAPHIC AND CLIMATOLICAL MODELS IN A GEOGRAPHICAL DATA BASE TO IMPROVE LANDSAT MSS CLASSIFICATION FOR OLYMPIC NATIONAL PARK
WILLIAM G. CIBULA (NASA, National Space Technology Laboratories, Bay St. Louis, MS) and MAURICE O. NYQUIST (National Park Service, Geographic Information Systems Field Unit, Denver, CO) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 53, Jan. 1987, p. 67-75. NASA-supported research. refs

An unsupervised computer classification of vegetation/landcover of Olympic National Park and surrounding environs was initially carried out using four bands of Landsat MSS data. The primary objective of the project was to derive a level of landcover classifications useful for park management applications while maintaining an acceptably high level of classification accuracy. Initially, nine generalized vegetation/landcover classes were derived. Overall classification accuracy was 91.7 percent. In an attempt to refine the level of classification, a geographic information system (GIS) approach was employed. Topographic data and watershed boundaries (inferred precipitation/temperature) data were registered with the Landsat MSS data. The resultant boolean operations yielded 21 vegetation/landcover classes while maintaining the same level of classification accuracy. The final classification provided much better identification and location of the major forest types within the park at the same high level of accuracy, and these met the project objective. This classification could now become inputs into a GIS system to help provide answers to park management coupled with other ancillary data programs such as fire management.

A87-30982
LAND APPLICATIONS FOR REMOTE SENSING FROM SPACE

The benefits and limitations of space-based remote sensing of the earth as a tool for resource mapping are discussed and illustrated with numerous photographic reproductions. The need for such capability, i.e., for a whole-earth view, is driven by an explosively increasing population growth rate, the finite, dwindling amount of accessible terrestrial resources, and the growth per capita demand for those resources. The methods used for applying remote sensing imagery for resource assessment are summarized, with criteria for selecting the best of many possible images and the constraints on the usefulness of the images. A comparison is made between the capabilities of spaceborne and airborne photography. Techniques which are used to enhance remotely-sensed images are illustrated with an integrated set of NOAA Nimbus 7 Coastal Zone Color Scanner images.

M.S.K.

N87-15579#
Universite Catholique de Louvain (Belgium). Inst. d'Astronomie et de Geophysique.
ESTIMATION OF SURFACE ALBEDO USING SATELLITE DATA. A SIMPLE FORMULATION FOR ATMOSPHERIC EFFECTS
Avai: NTIS HC A99/MF A01

Using a short wave radiative transfer model, a simple formulation (a set of graphical representations) to help eliminate the effects of large aerosol amounts on measurements of surface albedo from LANDSAT multispectral scanner data was derived. Monitoring of surface reflectivity over large areas using the model may be performed after determining the spectral reflectivity of calibration areas and ground truth observations. The aerosol concentration could then be determined and, after assuming that the aerosol concentration is laterally homogeneous, this optical depth may be used to recover the albedo of large surfaces surrounding the calibration area. Limitations of the method are outlined.

ESA

N87-17175#
Instituto de Pesquisas Espaciais, Sao Paulo (Brazil).
ENVIRONMENTAL MODIFICATION OF METROPOLITAN AREAS THROUGH SATELLITE IMAGES: STUDY OF URBAN DESIGN IN THE TROPICS
Avai: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The application of remote sensing to identification of Sao Paulo's urban land use patterns, and the relationships between these uses and urban heat island effects, including air pollution, is described. Results show a pattern of temperature according to urban land use class. Highest temperatures are registered where the concentration of industries and buildings is heaviest. Conversely, municipalities, large green areas, and water reservoirs register the lowest readings. The horizontal thermal gradient in Sao Paulo, in stable atmospheric conditions, shows the greatest gradients in temperature. The thermal gradient intensity in the heat island is over 10 C, far surpassing measurements taken among cities in midlatitudes.

ESA
MOBILE VERY LONG BASELINE INTERFEROMETRY AND GLOBAL POSITIONING SYSTEM MEASUREMENT OF VERTICAL CRUSTAL MOTION


Mobile Very Long Base Interferometry (VLBI) and Global Positioning System (GPS) geodetic measurements have many error sources in common. Calibration of the effects of water vapor on signal transmission through the atmosphere, however, remains the primary limitation to the accuracy of vertical crustal motion measurements made by either technique. The two primary methods of water vapor calibration currently in use for mobile VLBI baseline measurements were evaluated: radiometric measurements of the sky brightness near the 22 GHz emission line of free water molecules and surface meteorological measurements used as input to an atmospheric model. Based upon a limited set of 9 baselines, it is shown that calibrating VLBI data with water vapor radiometer measurements provides a significantly better fit to the theoretical decay model than calibrating the same data with surface meteorological measurements. The effect of estimating a systematic error in the surface meteorological calibration is shown to improve the consistency of the vertical baseline components obtained by the two calibration methods. A detailed error model for the vertical baseline components obtained indicates current mobile VLBI technology should allow accuracies of order 3 cm with WVR calibration and 10 cm when surface meteorological calibration is used.

Author
A87-28504

A87-29977* Colorado Univ., Boulder.
Observational results for the earth's C21 and S21 gravity coefficients can be used to constrain the mean equatorial rotation of the core with respect to the mantle. Current satellite gravity solutions suggest the equatorial rotation rate is no larger than one order of magnitude smaller than the present rate inferred from the westward drift of the earth's magnetic field. The next generation gravity solutions should improve this constraint by more than one order of magnitude. Implications for the fluid pressure at the core-mantle boundary and for the shape of that boundary are discussed.

A87-17415† Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying
Further development of utility program software for analyzing final results of Earth rotation parameter determination from different space geodetic systems was completed. Main simulation experiments were performed. Results and conclusions were compiled. The utilization of range-difference observations in geodynamics is also examined. A method based on the Bayesian philosophy and entropy measure of information is given for the elucidation of time-dependent models of crustal motions as part of a proposed algorithm. The strategy of model discrimination and design of measurements is illustrated in an example for the case of crustal deformation models.
B.G.

Since 1975, the Defense Mapping Agency (DMA) has been determining polar motion as a byproduct of computing the precise orbits of the Navy Navigation Satellite System (NNSS) satellites. The orbit determination process currently incorporates the NSWC 922 terrestrial reference system and the NWL 10E-1 Earth Gravitational Model (EGM) to degree 28 and order 27. The World Geodetic System 1984 (WGS 84), developed by DMA, will replace the NSWC 922/10E-1 system for NNSS orbit determination. The WGS 84 EGM to degree and order 41 will be used. This paper presents the results of two experiments which compared pole positions computed in the two systems. These comparisons indicate that use of WGS 84 improves agreement between pole position values resulting from the Nova-class satellite orbit solutions and the values determined by other modern techniques.

N87-18908 Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
HOMOGENEOUS PLATE DEFORMATIONS ON A SPHERE AS MONITORED BY SATELLITE LASER RANGING (SLR) NETWORKS ANALYZED WITH THE MULTI-EPOCH METHOD Thesis B. J. DUESMANN 1986 184 p (ETN-87-99221) Avail: NTIS HC A09
An expression between parameters describing the form of a satellite laser ranging network at different epochs and (spherical) parameters describing a matching deformation for each plate was derived. The deformation, the network, the measurements, and the reference coordinate system should fulfill the following conditions: all network sites are visited twice at least; the coordinates are given in orthonormal coordinate systems with corresponding covariance matrices; all network sites are known in one orthonormal reference coordinate system with a known absolute positioning; the deformation of a plate is small, homogeneous, and time-independent; and the size of each plate is limited.

04 GEOLOGY AND MINERAL RESOURCES
Includes mineral deposits, petroleum deposits, spectral properties of rocks, geological exploration, and lithology.

A87-20689* VOLCANOLOGY FROM SPACE - USING LANDSAT THEMATIC MAPPER DATA IN THE CENTRAL ANDES P. W. FRANCIS and R. MCALLISTER EOS (ISSN 0036-3941), vol. 67, April 8, 1986, p. 170, 171. (Contract NASW-4066; NASS-28759)
The use of the Landsat thematic mapper to identify potentially active Andean volcanos and to study the history of individual volcanos is discussed. A thematic mapper image of the 6150-m-high Soumpora volcano is presented and it is noted that TM data have played a valuable role in tracking debris streams in the avalanche derived from the different parts of the original volcanic edifice. The consequences of Landsat commercialization are considered.

K.K.
A87-23782  
**ROCK TYPE DISCRIMINATION WITH AI-BASED TEXTURE ANALYSIS ALGORITHMS**


The goal of this study was to test whether it was possible to extract granite with Landsat MSS data in the arid regions of the United States. The test site for the experiments was the Duffer Peak Quadrangle, NV. The image processing methods examined included both supervised and unsupervised classification techniques. The training sets were independently selected by researchers associated with the U.S. Geological Survey. The results indicate that a combination of supervised and unsupervised classification methods can accurately delineate the boundary of the granite with a reasonable understanding that the Landsat sensed only the surficial material rather than the bedrock. From these experiments, it is reasonable to conclude that granite in arid regions can be extracted within a reasonable level of accuracy from Landsat data. The decision maps from such automated analysis should be interpreted as a generalization of surficial material rather than the bedrock of the area.

**A87-24274**

**GEOLOGICAL NATURE OF EARLY PRECAMBRIAN FORMATIONS (CONSIDERING THE EXAMPLE OF THE ANABAR SHIELD): [O GEOFIZIKESKII PRIRODE RANNEDOKEM-BRISIIKH OBRAZOVANII NA PRIMERE ANABARSKOGO SHCHITA]**


In Russian. refs

The primordial nature of the catachean-early Proterozoic crystalline formations making up the Anabar shield is analyzed on the basis of a variety of data, including Landsat observations. The shield is found to have a layered structure and a massively stratified rhythmic texture, consisting of geometrically regular layer-horizons, from several centimeters to several dozens of meters thick.

B.J.

**A87-24380**

**ANALYSIS OF CORRELATIONS BETWEEN STRUCTURAL ELEMENTS DETECTED ON SPACE IMAGES AND METALLOGENIC ZONES [OTSENKA KORELLETSII VNITRNIKH SVIAZEI MEZHDU STRUKTURNYMI ELEMENTAMI, VYIAVLENNymi PO KOSMICHESKIM SNIMKAM, I METALLOGENICHESKIMI ZONAMI]**


Structural features recognized on space images and identified on a 1,500,000 space-geological map were correlated with locations of metallogenic zones in the northeastern Transbaikal region, shown on a 1:2,500,000 metallogenic map. Two to three highly informative indicators were found for four out of the total six metallogenic zones. These four zones are characterized by high coefficients of uniformity, defined as the degree of similarity between the lineament network on the reference sites and on the rest of the study area.

I.S.

**A87-24381**

**INTEGRATION OF SPACE-GEOLOGICAL AND GEOPHYSICAL METHODS IN REGIONAL AND LOCAL PREDICTIONS OF TECTONIC STRUCTURES IN THE CASPIAN DEPRESSION [KOMPLEKSIROVANIE KOSMOGEOFIZIKESKIH I GEOFIZIKESKIIKH METODOV PRI REGIONAL'NYKH I LOKAL'NYKH PREDIKTII] TEKTONICHESKICH STRUKTUR V PRIKASPIIKOI VPADINE]**

V. I. MIKHAILOV (Belorusskii Politekhnicheskii Institut, Minsk, Belorussian SSR), V. N. GUBIN (Belorusskii Nauchno-issledovatel'ski Geologorazvedochnyi Institut, Minsk, Belorussian SSR), and A. A. MAKAREVICH (TSentral'nyi Nauchno-Issledovatel'ski Institut Kompleksnogo Issledovaniya Vodnykh Resursov, Minsk, Belorussian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1986, p. 51-60. In Russian. refs

**A87-24382**

**IDENTIFICATION OF RECLAIMED LANDSCAPES OF BELORUSSIA FROM SPACE IMAGES [INDIKATSIIA MELIORIRUEMYKH LANDSHAFTOV BELORUSSII PO KOSMICHESKIM SNIMKAM]**

V. I. MIKHAILOV (Belorusskii Politekhnicheskii Institut, Minsk, Belorussian SSR), V. N. GUBIN (Belorusskii Nauchno-issledovatel'ski Geologorazvedochnyi Institut, Minsk, Belorussian SSR), and A. A. MAKAREVICH (TSentral'nyi Nauchno-Issledovatel'ski Institut Kompleksnogo Issledovaniya Vodnykh Resursov, Minsk, Belorussian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1986, p. 61-67. In Russian. refs

**A87-24383**

**USE OF SPACE IMAGERY AND GEOPHYSICAL DATA IN METALLOGENIC PREDICTION STUDIES IN CENTRAL KYZYLKUM [ISPOL'ZOVANIE KOSMICHESKIKH SNIMKOV I GEOFIZIKESKIIKH DANNYKH PRI PROGNOZNO-METALLOGENICHESKIKH ISSLEDOVANIYakh VTSentral'nykh KYZYLKUMakh]**


**A87-24384**

**LINEAMENTS OF EASTERN CUBA - GEOLOGICAL INTERPRETATION OF AERIAL AND SPACE IMAGERY [LINEAMENTS VOSTOKA KUBY - OPYTY GEOFIZIKESKIIH INTERPRETIIASSII AERO- I KOSMICHESKIIH BOZHOBRAZHENII]**

V. I. MAKAROV, V. G. TRIFONOY, G. I. VOLTCHKOVA, F. FORMEL, K. BREZHIANSKII (AN SSSR, Geologicheskii Institut, Moscow, USSR; Academia de Ciencias de Cuba, Instituto de Geologia y Paleontologia, Havana, Cuba) et al. Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1986, p. 75-85. In Russian. refs

**A87-24866**

**STRUCTURE OF THE KERGUELEN PLATEAU PROVINCE FROM SEASAT ALTIMETRY AND SEISMIC REFLECTION DATA**


The results of a new analysis of the Kerguelen Plateau province's structure employing both Seasat and newly acquired multichannel seismic data for ground truth are reported. The northern sector is characterized by volcanism and a sedimentary basin; the southern sector by a broad anticlinal arc, major faulting, and a sedimentary basin; and the eastern sector by abyssal basin and bounding ridge. The three sectors argue for a more complex tectonic evolution of the feature than has been previously proposed.

C.D.
A87-25588* Arkansas Univ., Fayetteville.

PRELIMINARY ANALYSES OF SIB-B RADAR DATA FOR RECENT HAWAII LAVA FLOWS

The Shuttle Imaging Radar (SIR-B) experiment acquired two L-band (23 cm wavelength) radar images (at about 28 and 48 deg incidence angles) over the Kilauea Volcano area of southeastern Hawaii. Geologic analysis of these data indicates that, although aa lava flows and pyroclastic deposits can be discriminated, pahoehoe lava flows are not readily distinguished from surrounding low return materials. Preliminary analysis of data extracted from isolated flows indicates that flow type (i.e., aa or pahoehoe) and relative age can be determined from their basic statistics and illumination angle.

A87-25590

EARTH SENSING - NEW TOOLS ENABLE SCIENTISTS TO GAIN INSIGHT INTO THE STRUCTURE OF OUR PLANET'S SURFACE
DAVID S. MEYER Commercial Space (ISSN 8756-4831), vol. 2, Fall 1986, p. 70, 71, 73.

The uses of a thematic mapper (TM) and imaging spectrometer to identify and map the earth's composition are evaluated. The TM detects mineral composition by measuring reflected solar radiation and the imaging spectrometer can directly identify and map minerals. The applications of the TM to the study of the Meatz in the Eastern Desert of Egypt and of the TM and imaging spectrometer to the analysis of the Wind River Basin in Wyoming are described. The development of an expert system to interpret imaging spectrometer data is proposed and advances in image spectrometry are discussed.

A87-26532

METHODS OF GEOLOGICAL INTERPRETATION OF LINEAMENTS OF PLATFORM AREAS (WITH REFERENCE TO USTIURT) [PRIEMY GEOLOGICHESKOI INTERPRETAT'SII LINEAMENTOV PLATFORMENNYKH TERRITORII /NA PRIMERE USTIURT'I/]

Two approaches are suggested for geological interpretation of lineaments on satellite images. One, the geodynamic approach, is based on the analysis of geometrical characteristics of lineaments that vary with the geodynamic conditions. The geometric parameters analyzed in this approach include the lineament length, direction, and distribution density; the analysis includes examination of the relationship of the lineaments with plicative structures, systematic displacements by the lineaments of tectonic structures, and the characteristic features of the lineament pattern. The second approach to lineament interpretation, the landscape approach, relies entirely on the comparison of topographic characteristics of the lineaments. The use of each approach is illustrated by geological interpretation of the lineaments on the territory of the Ustiuut plateau.

A87-26533

THE PRINCIPLES AND PROCEDURES OF MODELLING ORE-RELATED OBJECTS IN PREDICTIVE METALLOGENIC INVESTIGATIONS (USING SATELLITE-BORNE DATA) [PRINTISIPY I METODIKA MODELIROVANIYA RUDNYKH OB'EKTOV PRI PROGOZNO-METALLOGENICHESKIIH ISSLEDOVANIIAKH /IS POL'ZOVANIIEM KOSMICHESKII INFORMATSII/]

Two classes of models for representing ore-related objects are described, along with the relevant implementation algorithms. One model class, the 'type model', represents an ordered description of the combination of the most typical features included in the model regardless of their occurrence outside the limits of an ore object. The other model type, the 'optimal model', is based on an ordered description of unique ore-related features selected from the features of the entire analyzed area, taking into account the distribution of the characteristics possessing predictive features outside known ore objects. The use of these model types is illustrated by developing ore cluster models from satellite-borne and field geological data.

A87-26534

QUANTITATIVE PROCESSING PROCEDURES AND THE INFORMATION CONTENT OF SPACE IMAGERY IN PREDICTIONS OF STRUCTURAL INHOMOGENEITIES OF THE SEDIMENTARY COVER [KOLICHVESTVENNYE METODY OBRABOTKI I INFORMATIVNOST' KOSMICHESKIKH SNIMKOV PRI PROGOZNOIROVANI STRUKTURNYKH OBNORODNOSTEI OSADOCHNOGO CHEKHILA]

The steps of a quantitative processing scheme designed for obtaining predictive geological information from space photographs are described. Use of information-bearing indicators in developing a geological and geophysical model that represents the geology of a target is discussed. As an application example, the predictive value of space photography is demonstrated for the area of the Caspian Depression.

A87-26508

INVESTIGATION OF SPECTRAL CORRELATIONS OF VEGETATION GROWING ON DIFFERENT TYPES OF GEOLOGICAL STRUCTURES [ISSLEDOVANIE SPEKTRAL'-NYKH KORRELJATSIIONNYKH SVIAZEI RASTITEL'NYKH OB'RAZOVANII, PROIZRASJATUISHCHIKH NA RAZLICHNYKH GEOLOGICHESKIKH STRUKTURAKH]

The paper describes a technique for determining correlations between the spectral brightness structure of the underlying surface and its geological properties on the basis of the statistical processing of aerial-photography data. The possibility of determining the petroleum content of a geological structure on the basis of brightness measurements is noted. Experimental results are presented.
A87-29010
A COMPARATIVE STUDY OF LINEAMENT ANALYSIS FROM DIFFERENT REMOTE SENSING IMAGERY OVER AREAS IN THE BENUE VALLEY AND JOS PLATEAU NIGERIA
A comparison is made between lineament analyses made from side-looking radar (SLAR) imagery, Landsat and aerial photographs from an area on the Lamurde anticline (Benue Valley) and from an area of ring dyke complexes (Jos Plateau), Nigeria. Fault lineaments are, in general, well expressed on side-looking airborne radar with the exception of those lineaments oriented parallel or subparallel to the radar look direction. Look direction and radar incidence angle influence lineament detectability. Specifically the lineaments oriented perpendicular to the sun azimuth direction on the Landsat image were over-represented. Landsat, Star and aerial photographs can be used in a complementary way; the first two for reconnaissance-type surveys and lineament analysis, the third for detailed surveying.

Author

A87-29011
AN ANALYSIS OF GEOLOGIC LINEAMENT SEEN ON LANDSAT MSS IMAGERY
Lineament maps drawn from several Landsat images of a part of north Wales and western England display considerable variation in the number of lineaments identified. Analysis of the maps shows that it is not the case that maps with fewer lineaments are simply subsets of those with many lineaments. Rather, each map contains a high proportion of lineaments that are unique to it. Despite these differences, the same preferred lineament orientation is identified from almost all maps. These results imply that all available Landsat imagery may usefully contribute to a lineament analysis, little value may be placed on the density of lineaments seen on any one image and preferred lineament orientation is relatively easy to identify. It is concluded that guarded use may be made of lineament analysis in geology. Lineament maps may be employed to suggest hypotheses rather than to test them.

Author

A87-30126
DISCRIMINATION OF ALTERED BASALTIC ROCKS IN THE SOUTHWESTERN UNITED STATES BY ANALYSIS OF LANDSAT THEMATIC MAPPER DATA
PHILIP A. DAVIS, PAT S. CHAVEZ, JR. (USGS, Flagstaff, AZ), and GRAYDON L. BERLIN (Northern Arizona University, Flagstaff, AZ) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 53, Jan. 1987, p. 45-55. refs
Landsat Thematic Mapper image data were analyzed to determine their ability to discriminate red cone basalts from gray flow basalts and sedimentary country rocks for three volcanic fields in the southwestern United States. Analyses of all of the possible three-band combinations of the six nonthermal bands indicate that the combination of bands 1, 4, and 5 best discriminates among these materials. The color-composite image of these three bands unambiguously discriminates 89 percent of the mapped red volcanic cones in the three volcanic fields. Mineralogic and chemical analyses of collected samples indicate that discrimination is facilitated by the presence of hematite as a major mineral phase in the red cone basalts (hematite is only a minor mineral phase in the gray flow basalts and red sedimentary rocks). Discrimination between red cone basalts and red sedimentary rocks is aided by the presence of large quantities of carbonate, sulfate, and clay minerals in the sedimentary rocks.

Author

A87-30084
GEOPHYSICAL REMOTE SENSING
(Contract NGL-05-007-004)
The types of remote sensing images which have applications in geophysical studies are reviewed. Features of the Shuttle Imaging Radar, a synthetic aperture radar, are described and a sample image is provided to illustrate the capabilities for mapping large-scale geological structure. A combined Landsat-Seasat image is shown to yield data on crustal composition. Sea surface topographic features that result from gravitational effects are demonstrated to be amenable to characterization with another Seasat instrument, a radar altimeter. Magsat data allow identification of magnetic perturbations produced by crustal magnetization. Finally, auroral imagery gathered with the Atmospheric Dynamics Explorer are presented which show that the effects of particles bombarding the atmosphere can be detected at UV wavelengths.

M.S.K.

N87-17117
ARIZONA STATE UNIV., TEMPE. DEPT. OF GEOLOGY.
THERMAL IMAGING SPECTROSCOPY IN THE KELSO-BAKER REGION, CALIFORNIA
Avail: NTIS HC A05/MF A01 CSCL 14E
The ability of the Thermal Infrared Multispectral Scanner (TIMS) data to identify rock composition using thermal-infrared spectroscopy was assessed. A region was selected with a wide range of rock and soil types in an arid environment, and the spectra acquired by TIMS was compared to laboratory spectra of collected samples. A TIMS image was acquired of the Kelso-Baker region in the Mojave desert of California at a surface resolution of approximately 7 m. This image was then used to map the areal extent of each geologic component. The TIMS data provided an excellent means for discriminating and mapping rocks of very similar mineralogy. These findings suggest that thermal-infrared spectroscopy can provide a powerful tool for identifying and mapping rock composition on the Earth and other terrestrial planets.

B.G.

N87-17118
JETFIPULATION LAB., CALIFORNIA INST. OF TECH., PASADENA. GEOLOGY GROUP.
LITHOLOGIC MAPPING OF SILICATE ROCKS USING TIMS
A. R. GILLESPIE in its The TIMS Data User's Workshop p 29-44 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 06B
Common rock-forming minerals have thermal infrared spectral features that are measured in the laboratory to infer composition. An airborne Daedalus scanner (TIMS) that collects six channels of thermal infrared radiance data (8 to 12 microns), may be used to measure these same features for rock identification. Previously, false-color composite pictures made from channels 1, 3, and 5 and emissivity spectra for small areas on these images were used to make lithologic maps. Central wavelength, standard deviation, and amplitude of normal curves regressed on the emissivity spectra are related to compositional information for crystalline igneous silicate rocks. As expected, the central wavelength varies systematically with silica content and with modal quartz content. Standard deviation is less sensitive to compositional changes, but large values may result from mixed admixture of vegetation. Compression of the six TIMS channels to three image channels made from the regressed parameters may be effective in improving geologic mapping from TIMS data, and these synthetic images may form a basis for the remote assessment of rock composition.

Author
DETECTION AND MAPPING OF VOLCANIC ROCK ASSEMBLAGES AND ASSOCIATED HYDROTHERMAL ALTERATION WITH THERMAL INFRARED MULTISPECTRAL SCANNER (TIMS) DATA COMSTOCK LODGE MINING DISTRICT, VIRGINIA CITY, NEVADA
JAMES V. TARANIK, AMY HUTSINPILLER, and MARCUS BORENGASSER In JPL, California Inst. of Technology The TIMS Data User's Workshop p 45-47 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08K

Thermal Infrared Multispectral Scanner (TIMS) data were acquired over the Virginia City area on September 12, 1984. The data were acquired at approximately 1130 hours local time (1722 IRIG). The TIMS data were analyzed using both photointerpretation and digital processing techniques. Karhuuen-Loeve transformations were utilized to display variations in radiant spectral emittance. The TIMS image data were compared with color infrared metric camera photography, LANDSAT Thematic Mapper (TM) data, and key areas were photographed in the field.

N87-17120*# Geological Survey, Denver, Colo.
SIMULATION MODELING AND PRELIMINARY ANALYSIS OF TIMS DATA FROM THE CARLIN AREA AND THE NORTHERN GRAPEVINE MOUNTAINS, NEVADA
KEN WATSON, SUSANNE HUMMER-MILLER, and FRED A. KRUSE In JPL, California Inst. of Technology The TIMS Data User's Workshop p 48-49 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08B

A theoretical radiance model was employed together with laboratory data on a suite of igneous rock to evaluate various algorithms for processing Thermal Infrared Multispectral Scanner (TIMS) data. Two aspects of the general problem were examined: extraction of emissivity information from the observed TIMS radiance data, and how to use emissivity data in a way that is geologically meaningful. The four algorithms were evaluated for appropriate band combinations of TIMS data acquired on both day and night overflights of the Tuscarora Mountains, including the Carlin gold deposit, in north-central Nevada. Analysis of a color composited PC decorrelated image (Bands 3, 4, 5--blue/green/red) of the Northern Grapevine Mountains, Nevada, area showed some useful correlation with the regional geology. The thermal infrared region provides fundamental spectral information that can be used to discriminate the major rock types occurring on the Earth's surface.

N87-17121*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
APPLICATION OF TIMS DATA IN STRATIGRAPHIC ANALYSIS
H. R. LANG In its The TIMS Data User's Workshop p 50-52 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08B

An in-progress study demonstrates the utility of Thermal Infrared Multispectral Scanner (TIMS) data for unraveling the stratigraphic sequence of a western interior, North American foreland basin. The TIMS data can be used to determine the stratigraphic distribution of minerals that are diagnostic of specific depositional distribution. The thematic mapper (TM) and TIMS data were acquired in the Wind River/Bighorn area of central Wyoming in November 1982, and July 1983, respectively. Combined image processing, photogeologic, and spectral analysis methods were used to: map strata; construct stratigraphic columns; correlate data; and identify mineralogical facies.

N87-17125*# Forest Service, Atlanta, Ga.
LOCATING SUBSURFACE GRAVEL WITH THERMAL IMAGERY
DOUGLAS E. SCHOLEN, WILLIAM H. CLERKE, and DOUGLAS E. LUEPKE In JPL, California Inst. of Technology The TIMS Data User's Workshop p 59 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08G

A method was discussed for using 6 band thermal imagery to locate subsurface gravel deposits in vegetated areas. Geologic history is reviewed to select potential areas of study. An overflight was made using a thermal scanner. The data were processed with a computerized system to delineate areas showing a quartz signature radiated by a gravel deposit. The method was developed during a search for gravel on National Forest land in Louisiana. Processed data from thermal imagery was compared with known gravel deposits and exploratory drill hole logs. A high correlation was noted for a wide range of deposits, from commercial pits to trace deposits only a foot thick. Overburden at these sites varied from zero to sixty feet, near the maximum annual penetration by the thermal wave. It was concluded that the method can be used to locate buried gravel deposits and that more time and effort are needed to verify the usefulness for developing gravel pits adjacent to proposed construction sites.

N87-17128*# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
THE RED RIVER VALLEY ARCHEOLOGICAL PROJECT
Abstract Only
JACK BENNETT, LAWSON SMITH, and MARK LAUSTRUP (Nebraska Univ., Omaha) In JPL, California Inst. of Technology The TIMS Data User's Workshop p 63-64 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08H

The Red River Valley Archeological Project is a long-term effort involving numerous individuals and institutions engaged in archeological investigations in the Texas and Oklahoma portions of the Red River Valley. To date the focus of the project was on site location. The project acquired both Thermal Infrared Multispectral Scanner (TIMS) TM, and color infrared photographs over a significant portion of the project area in an effort to define signatures for archeological sites and to assist in the detailed geomorphological mapping of the flood plain. Preliminary analysis of acquired data indicates that both the TIMS and TMS can make a substantial contribution to landform definition, the identification of cultural resources, and to the clarification of site-landform correlations in this riverine environment.

N87-17129*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
THE PHYSICAL BASIS FOR SPECTRAL VARIATIONS IN THERMAL INFRARED EMITTANCE OF SILICATES AND APPLICATION TO REMOTE SENSING
LOUIS S. WALTER In JPL, California Inst. of Technology The TIMS Data User's Workshop p 65-66 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08G

The use of infrared spectroscopy for the remote characterization of planetary surfaces has received attention due to efforts in the investigation of these bodies from space. In the 8 to 14 micron region there is a depression in the emission spectra of rocks (sometimes called reststrahlen) is related to the fundamental stretching vibrations of Si-O bonds and shifts in the locations of this feature are ascribed to variations in rock composition. Thus, it should be possible to investigate, quantify, and model the relationships of reststrahlen spectral band location through silicate mineralogical composition to rock classification. This concept will be tested first through the use of laboratory-acquired data on the infrared spectra and mineralogy of selected mineral and rock samples. As a suitable classification model is developed, it will be tested through overflights of appropriate rock outcrops using the Thermal Infrared Multispectral Scanner (TIMS).

INFRARED SPECTROSCOPY FOR GEOLOGIC INTERPRETATION OF TIMS DATA
MARY JANE BARTHOLOMew In its The TIMS Data User's Workshop p 65-66 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 08G

The Portable Field Emission Spectrometer (PFES) was designed to collect meaningful spectra in the field under climatic, thermal, and sky conditions that approximate those at the time of the overflight. The specifications and procedures of PFES are discussed. Laboratory reflectance measurements of rocks and
minerals were examined for the purpose of interpreting Thermal Infrared Multispectral Scanner (TIMS) data. The capability is currently being developed to perform direct laboratory measurement of the normal spectral radiance of Earth surface materials at low temperatures (20 to 30 °C) at the Jet Propulsion Laboratory. B.G.

N87-17133#  Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A GEOLOGIC ATLAS OF TIMS DATA
ELSA ABBOTT  In its The TIMS Data User's Workshop p 74-75 1 Nov. 1986
Avail: NTIS HC A05/ MF A01 CSCL 05B

In the three years since the first data were taken, it was well demonstrated that the Thermal Infrared Multispectral Scanner (TIMS), properly used, can be a most valuable tool for the geologist. Compilation of the TIMS data into a geological atlas was felt to be useful. Several data sets were extensively studied to establish TIMS as a geologic tool and to explore the optimum enhancement techniques. It was found that a coloration stretch of bands 1, 3, and 5 enhance the data to a form that is very useful and this enhancement will be used in the geographic atlas along with an accompanying geologic map and description. Many data sets are well published and familiar to TIMS users, but there are some sets that, for lack of time and funds, were not thoroughly studied or published. A short description of the least studied and most data sets that for lack of published TIMS images presented along with the many previously studied and published TIMS images constitute an enormously useful set of information for the geologist in the 8 to 10 micron range.

B.G.


AIRBORNE THERMAL INFRARED MULTISPECTRAL SCANNER (TIMS) IMAGES OVER DISSEMINATED GOLD DEPOSITS, OSGOOD MOUNTAINS, HUMBOLDT COUNTY, NEVADA
M. DENNIS KROHN  In JPL, California Inst. of Technology The TIMS Data User's Workshop (date) p 76-78 1 Nov. 1986
Avail: NTIS HC A05/ MF A01 CSCL 06G

The U.S. Geological Survey (USGS) acquired airborne Thermal Infrared Multispectral Scanner (TIMS) images over several disseminated gold deposits in northern Nevada in 1983. The aerial surveys were flown to determine whether TIMS data could depict jasperoids (siliceous replacement bodies) associated with the gold deposits. The TIMS data were collected over the Pinson and Getchell Mines in the Osgood Mountains, the Carlin, Maggie Creek, Bootstrap, and other mines in the Tuscarora Mountains, and the Jerntt Canyon Mine in the Independence Mountains. The TIMS data seem to be a useful supplement to conventional geological exploration for disseminated gold deposits in the western United States. Siliceous outcrops are readily separable in the TIMS image from other types of host rocks. Different forms of silification are not readily separable, yet, due to limitations of spatial resolution and spectral dynamic range. Features associated with the disseminated gold deposits, such as the large intrusive bodies and fault structures, are also resolvable on TIMS data. Inclusion of high-resolution thermal inertia data would be a useful supplement to the TIMS data.

B.G.


TECTONIC GEOMORPHOLOGY OF THE ANDES WITH SIR-A AND SIR-B
ARTHUR L. BLOOM and ERIC J. FIELDING  In JPL The Second Spaceborne Imaging Radar Symposium p 5-10 1 Dec. 1986
Avail: NTIS HC A10/ MF A01 CSCL 08G

Data taken from SIR-A and SIR-B (Shuttle Imaging Radar) crossed all of the principal geomorphic provinces of the central Andes between 17 and 34 S latitude. In conjunction with Thematic Mapper images and photographs from hand-held cameras as well as the Landsat images, the two Passes flown with SIR-B, the radar images give an excellent sampling of Andean geomorphology. In particular, the radar images show new details of volcanic rocks and landforms of late Cenozoic age in the Puna, and the exhumed surfaces of tilted blocks of Precambrian crystalline basement in the Sierras Pampeanas.

E.R.

N87-17137#  Chevron Oil Field Research Co., La Habra, Calif.

SPACE SHUTTLE RADAR IMAGES OF INDONESIA
FLOYD F. SABINS and JOHN P. FORD  (Jet Propulsion Lab., California Inst. of Tech., Pasadena) In JPL The Second Spaceborne Imaging Radar Symposium p 11-16 1 Dec. 1986
Avail: NTIS HC A10/ MF A01 CSCL 171

Sabins (1983) interpreted Shuttle Imaging Radar (SIR)-A images of Indonesia; Sabins and Ford (1985) interpreted SIR-B images. These investigations had the following major results: (1) major lithologic assemblages are recognizable by their terrain characteristics in the SIR images, and (2) both local and regional geologic structures are mappable. These results are summarized.

Author

N87-17138#  Massachusetts Inst. of Tech., Cambridge. Earth Resources Lab.

DELINEATION OF FAULT ZONES USING IMAGING RADAR
Avail: NTIS HC A10/ MF A01 CSCL 08G

The assessment of earthquake hazards and mineral and oil potential of a given region requires a detailed knowledge of geological structure, including the configuration of faults. Delineation of faults is traditionally based on three types of data: (1) seismicity data, which shows the location and magnitude of earthquake activity; (2) field mapping, which in remote areas is typically incomplete and of insufficient accuracy; and (3) remote sensing, including LANDSAT images and high altitude photography. Recently, high resolution radar images of tectonically active regions have been obtained by SEASAT and Shuttle Imaging Radar (SIR-A and SIR-B) systems. These radar images are sensitive to terrain slope variations and emphasize the topographic signatures of fault zones. Techniques were developed for using the radar data in conjunction with the traditional types of data to delineate major faults in well-known test sites, and to extend interpretation techniques to remote areas.

Author


THE MEGAGEOMORPHOLOGY OF THE RADAR RIVERS OF THE EASTERN SAHARA
JOHN F. MCCUALEY, CAROL S. BREED, and GERALD G. SCHABER  In JPL The Second Spaceborne Imaging Radar Symposium p 25-36 1 Dec. 1986
Avail: NTIS HC A10/ MF A01 CSCL 08H

The Eastern Sahara is devoid of surface drainage; this unusual characteristic distinguishes its morphology from that of most other desert regions where running water dominates landscape development. A map derived from SIR-A/3 and LANDSAT images and the literature, shows the major presently known paleo-drainages in the Eastern Sahara. This compilation permits consideration of the key questions: Where did the radar rivers come from and where did they go? Analysis of SIR-A data led McCauley et al. to suggest that the radar rivers, because of their southwestward trend, once flowed into the Chad basin. This key North African feature is a regional structural low formed in the Early Cretaceous in response to initial opening of the South Atlantic. The problem of the origin of headwaters for the radar rivers was less tractable. The idea that the source areas of the radar rivers might originally have been the same as those later captured by the Nile was proposed tentatively. A more extensive review of
the Cenozoic tectonic history of North Africa reveals no reason now to support that the Central African tributaries of the present Nile were ever connected to the large alluvial valleys in southwestern Egypt and northwestern Sudan. E.R.

**N87-17140** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**GEOLOGICAL APPLICATIONS OF MULTIPOLARIZATION SAR DATA**

DIANE L. EVANS In its The Second Spaceborne Imaging Radar Symposium p 36-41 1 Dec. 1986

Avail: NTIS HC A10/MF A01 CSCL 08G

Spaceborne Synthetic Aperture Radar (SAR) data acquired by SEASAT and the Shuttle Imaging Radar (SIR-A/B) operating at L-band with HH polarization were found to be useful in conjunction with other sensors for lithologic discrimination in arid environments with limited vegetation cover. In order to assess the utility of more advanced sensors for geologic research and define the unique contributions each sensor makes, remote sensing data were collected over the Deadman Butte area of the Wind River Basin, Wyoming. The Wind River Basin is an asymmetric sedimentary basin in central Wyoming created during the early Eocene Laramide orogeny. The stratigraphic section of the Deadman Butte study area, which was measured by Woodward is made up of Paleozoic and Mesozoic marine shales, siltstones, limestones, and sandstones. Sensor systems included LANDSAT 4 Thematic Mapper (TM), Thermal Infrared Multispectral Scanner (TIMS) and the Multipolarization, L-band airborne SAR, a prototype for the next Shuttle Imaging Radar (SIR-C). Sensor parameters are given. Author

**N87-17146** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**A SCANNING RADAR ALTIMETER FOR MAPPING CONTINENTAL TOPOGRAPHY**

T. H. DIXON In its The Second Spaceborne Imaging Radar Symposium p 84-88 1 Dec. 1986

Avail: NTIS HC A10/MF A01 CSCL 08B

Topographic information constitutes a fundamental data set for the Earth sciences. In the geological and geophysical sciences, topography combined with gravitational information provides an important constraint on the structure and rheologic properties of the crust and lithosphere. Detailed topography data can also be used to map offsets associated with faulting and to reveal the effects of tectonic deformation. In the polar regions, elevation data form a crucial but as yet largely unavailable resource for studying ice sheet mass balance and ice flow dynamics. The vast Antarctic ice sheet is the largest fresh water reservoir on Earth and is an important influence on ocean circulation and global climate. However, our knowledge of its stability is so limited that we cannot even specify whether the Antarctic ice sheet is growing or shrinking. It is clear that there is need for high quality global topography data. A summary of potential applications with their resolution requirements is shown. Author

**N87-17232** Centre for Earth Science Studies, Trivandrum (India).

**SIGNIFICANCE OF SPACE IMAGE, AIR PHOTO AND DRAINAGE LINEARs IN RELATION TO WEST COAST TECTONICS, INDIA**


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Lineament patterns over northern Kerala along the western continental margin of India (WCMI) were analyzed in conjunction with the structural, geochronological, and geological data to understand the structural and geomorphic evolution of WCMI. The NNW and ENE sets are subparallel to the basic dyke swarms in the region. Regional structural framework reveals that S-S compressive stresses produced the NNW lineaments whereas the ENE trends represent younger tensional fractures developed due to near E-W compression. These fractures were periodically reactivated. Predominant air photo linears represent joints developed due to nontectonic stresses. Drainage development in the region is structurally controlled. Neotectonism involving vertical upliftment is suggested. ESA

**N87-17233** University of North-Eastern Hill, Shillong (India). School of Environmental Sciences.

**STRUCTURAL AND GEOMORPHIC EVOLUTION OF MEGHALAYA PLATEAU, INDIA ON LANDSAT IMAGERY**


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The remote areas of North East Region of India were studied by LANDSAT imagery to analyze geological, structural, and geomorphological characteristics. The potential of LANDSAT imagery for structural and geomorphic evolution studies of Meghalaya Plateau is shown. Results indicate that rivers adapted their courses to regional structure and lineaments. All the major lineaments run in SW-NE direction. Field evidence such as deep gorges, waterfalls, river terraces, and breaks in slopes indicate that the plateau presents multicyclic surfaces at different altitudes. ESA

**N87-17234** Karlsruhe Univ. (West Germany). Inst. fuer Photogrammetrie und Topographie.

**HYDROGEOLOGICAL RESEARCH IN PELOPONNESUS (GREECE) KARST AREA BY SUPPORT AND COMPLETION OF LANDSAT-THEMIC DATA**


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Karst drainage from Peloponnesian catchment areas to springs at the coast, and possible pathways to win the fresh water before its submarine discharge were investigated, using high resolution satellite data to support and complement hydrogeological research. The derived fracture pattern, separated into strike-slip faults and joints by field check, and combined with known karst cavities and fracture lineaments, gives clues for possible underground pathways of the water. By use of a special band combination of the reflective data, the recharge area is subdivided into several categories. Several submarine springs near the coast are detected by the thermal band of the LANDSAT Thematic Mapper. ESA

**N87-17235** Centre for Earth Science Studies, Trivandrum (India).

**COMPUTER-AIDED ANALYSIS OF LANDSAT DATA FOR MAPPING GEOLOGIC AND GEOMORPHIC FEATURES, NORTH BOMBAY, INDIA**


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Geologic and geomorphic information extraction from remotely sensed data using visual and computer aided techniques were attempted for a test area in North Bombay. Visual interpretations of LANDSAT images offer a limited possibility to demarcate terrain units. Computer aided analysis discriminates nine distinct spectral classes that correspond to various geomorphic/geologic units in the area. A combination of visual and computer aided techniques
in addition to field data enables the preparation of thematic maps.


**COMPARATIVE STUDY OF LANDSAT MSS, SALVYT-7 (TERRA) AND RADAR (SIR-A) IMAGES FOR GEOLOGICAL AND GEOMORPHOLOGICAL APPLICATIONS: A CASE STUDY FROM RAJASTHAN AND GUJARAT, INDIA**


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Rajasthan and Gujarat provinces of India were surveyed using the MKF-6 multispectral and KATE-140 stereo space photographs collected during the TERRA experiment and SIR-A radar data acquired during the flight of Columbia Space Shuttle on Nov. 12, 1981. A comparative evaluation of these data for geological applications indicates that lithological discrimination is possible from SIR-A due to differential surface roughness and from KATE-140 due to stereo vision. Structural elements on SIR-A and KATE-140 are better interpreted. Radar data is most suitable for different surface covers and thus provides better details for geomorphic mapping. It is also found that MKF-6 and LANDSAT MSS data provide better data on geomorphology in decreasing order; KATE-140 provides altitude variations and is, therefore, most helpful in pediplain areas.

**N87-17242#**  Stanford Univ., Calif. Dept. of Applied Sciences.

**INTERRELATIONSHIP BETWEEN FIELD SPECTRA AND AIRBORNE MSS SYSTEMS IN THE SINGATSE RANGE, (YERINGTON) NEVADA**


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Two stages of Singatse Range (Nevada) classical hydrothermal alterations of the felsic rock minerals to clays and other hydrous-bearing materials were mapped; early hypogene were associated with the Jurassic porphyry dike intrusion, and later geothermal (Jurassic/Cretaceous), associated with the circulation of meteoric waters beneath the cognetic volcanic pile. The whole rock mass of the Singatse Range was rotated 70 degW, so that what was once vertical is now flat-lying exposed over the 6Km of outcrop trending 290 deg (ESE-WNW) across the range. Due to the thin nature of the economically-interesting target, discrimination of lithologic units using LANDSAT TM spectral data were correlated with lithologic units, geobotanical forest associations, and geomorphic strutures indicating mineral interest zones were sought. For the analysis, eight bands were used, LANDSAT Thematic Mapper bands plus two more bands in the near infrared. The used algorithm, a discriminant analysis for computer based comparisons of the different rock types, is described. The spectral signatures, the ranking for the best bands, combinations of bands, and the classification accuracy are discussed.

**N87-17246#**  Dartmouth Coll., Hanover, N.H. Dept. of Earth Sciences.

**DISCRIMINATION OF LITHOLOGIC UNITS USING GEOBOTANICAL AND LANDSAT TM SPECTRAL DATA**


(Contract NASW-4049; JPL-956937)

Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08B

Thematic Mapper (TM) spectral data were correlated with lithologic units, geobotanical forest associations, and geomorphic parameters in the Ridge and Valley Province of Pennsylvania. Both the TM and forest association data can be divided into four groups based on their lithology (sandstone or shale) and geographic aspect (north or south facing). In this classic sedimentary terrain, geobotanical associations are useful indicators of lithology and these different geobotanical associations are detectable in LANDSAT TM data.

**N87-17247#**  Karlsruhe Univ. (West Germany). Inst. fuer Photogrammetrie und Topographie.

**RESULTS OF TECTONIC AND SPECTRAL INVESTIGATIONS ALONG THE WADI ARABA FAULT IN JORDAN USING SPECIAL PROCESSED THEMATIC MAPPING (TM) DATA**


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Tectonic and lithological investigations carried out in the Wadi Araba-Jordan graben area were supported by use of Mozambique) were retrieved for ore bodies research. Variables were analyzed through an approach that allows the user to integrate different sources of digital data and to infer the relationships among them, using display, mapping, and statistical analysis. On the basis of the interpretation of the relationships among multisource data, geological strutures indicating mineral interest zones were sought. The importance of circular structures and lineaments swarms for the emplacement of pegmatites and mineralized bodies was assessed. A hypothesis concerning mutual relationships among late Precambrian tectonic episodes was formulated for the study area.
LANDSAT/Thematic Mapper data. A processing concept was developed to satisfy the requirements for several user groups. Use of the data sets to complete supraregional tectonic research is discussed. The applicability of the processed data for registration of hydrothermal alteration minerals is demonstrated. The detection of an Fe-deposit is illustrated.


INTEGRATION OF SURFICIAL GEOCHEMISTRY AND LANDSAT IMAGERY TO DISCOVER SKARN TUNGSTEN DEPOSITS USING IMAGE ANALYSIS TECHNIQUES


A deposit model, LANDSAT imagery, and surficial geochemistry were used to develop a procedure for locating tungsten mineralization associated with shallowly buried intrusions. Image analysis techniques were used to develop a co-occurrence index, which was used to identify promising exploration targets.

N87-17293# Manitoba Univ., Winnipeg. Dept. of Geophysics.

APPLICATION OF 2-D HILBERT TRANSFORM IN THE INTERPRETATION OF REMOTELY SENSED POTENTIAL FIELD DATA


Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The relationships between the 2-D Hilbert transform and 3-D potential field data are studied and the application of these relations in geological remote sensing is investigated. In the overburden covered area, direct mapping of geological formations using LANDSAT or other short wavelength remote sensing data are not possible and it becomes necessary to use other available data sets. Most readily available geophysical data are the potential field data sets and the 2-D Hilbert transform method was tested and applied to digital potential field data sets to compute the first and second vertical derivatives. Results show that the method speeds up the processing, and that the vertical derivatives convincingly identify the subsurface geological boundaries.

N87-17294# Centre d'Étude Spatiale des Rayonnements, Toulouse (France).

COMPUTER-AIDED INTERPRETATION OF COMPLEX GEOLOGICAL PATTERNS IN REMOTE SENSING


Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A framework for aiding geological interpretation of remote sensing imagery, based on mathematical morphology for analyzing classified images is outlined. The case of a geologic fold is used to show ensambler and structuring methodology. In the first case, the direction antecedent is known. The extraction of the connected components representing the folding uses this hypothesis. In the second case, the searched information is the main direction. The searched information is the main direction. The phenomenon characterization must be protected from the disturbance caused by the orientation of other relief elements.

N87-17418# Purdue Univ., West Lafayette, Ind. Dept. of Earth and Atmospheric Sciences.

IMPROVING THE GEOLOGICAL INTERPRETATION OF MAGNETIC AND GRAVITY SATELLITE ANOMALIES Final Report, 1 Apr. 1985 - 31 Nov. 1986

WILLIAM J. HINZE, LAWRENCE W. BRAILE, and RALPH R. B. VONFRESE (Ohio State Univ., Columbus) Jan. 1987 124 p (Contract NAGW-736)

Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08G

Quantitative analysis of the geologic component of observed satellite magnetic and gravity fields requires accurate isolation of the geologic component of the observations, theoretically sound and viable inversion techniques, and integration of collateral, constraining geologic and geophysical data. A number of significant contributions were made which make quantitative analysis more accurate. These include procedures for: screening and processing orbital data for lithospheric signals based on signal repeatability and wavelength analysis; producing accurate gridded anomaly values at constant elevations from the orbital data by three-dimensional least squares collocation; increasing the stability of equivalent point source inversion and criteria for the selection of the optimum damping parameter; enhancing inversion techniques through an iterative procedure based on the superposition theorem of potential fields; and modeling efficiently regional-scale lithospheric sources of satellite magnetic anomalies. In addition, these techniques were utilized to investigate regional anomaly sources of North and South America and India and to provide constraints to continental reconstruction. Since the inception of this research study, eleven papers were presented with associated published abstracts, three theses were completed, four papers were published or accepted for publication, and an additional manuscript was submitted for publication.

Author
developed and apparently largely dependent spectrally on rock color contrast. Composite images which highlight some of the units in remarkable the high relative reflectance in longer wavelength bands (bands 5 from a highly evolved silici magmatic system represented today Agency)

This book, Geomorphology from Space: A Global Overview of Regional Landforms, was published by NASA STIF as a successor to the earlier works on the same subject: Mission to Earth: LANDSAT views the Earth, and ERTS-1: A New Window on Our Planet. The purpose of the book is threefold: first, to serve as a stimulant in rekindling interest in descriptive geomorphology and landforms analysis at the regional scale; second, to introduce the community of geologists, geographers, and others who analyze the Earth's surficial forms to the practical value of space-acquired remotely sensed data in carrying out their research and applications; and third, to foster more scientific collaboration between geomorphologists who are studying the Earth's landforms and astrogeologists who analyze landforms on other planets and moons in the solar system, thereby strengthening the growing field of comparative planetology. F.M.R.

A project to cover the entire territory of Egypt by a 1:500 000 geological map with a high degree of geometric accuracy and geologic reliability was started. LANDSAT-MS data served as a geometrically corrected map base after digital correction and mosaicing with the aid of Transit satellite points determined in the field, and as a means for geologic interpretation. Computer enhanced color composites were produced and interpreted. As an intermediate stage, a working sheet series of the entire area, comprising 80 sheets at a scale of 1:250 000, was printed to serve as a base for geologic and topographic interpretation. ESA

A series of false color composite images covering the volcanic cordillera was written. Each image is 45 km (1536 x 1536 pixels) and was constructed using bands 7, 4, and 2 of the Thematic Mapper (TM) data. Approximately 100 images were prepared to date. A set of LANDSAT Multispectral Scanner (MSS) images was used in conjunction with the TM hardcopy to compile a computer data base of all volcanic structure in the Central Andean province. Over 500 individual structures were identified. About 75 major volcanoes were identified as active, or potentially active. A pilot study was begun combining Shuttle Imaging Radar (SIR) data with TM for a test area in north Chile and Bolivia. B.G.

The Second Workshop on Remote Sensing/Lineament Applications for Energy Extraction was held April 23 to 24, 1986, at the Ramada Inn in Morgantown, West Virginia, and was

NTIS HC A02/MF A01 CSCL 08K

The Garlock and Death Valley fault zones in SE California are two active strike-slip faults coming together on the east side of the Avawatz Mtns. The kinematics of this intersection, and the possible continuation of either fault zone, are being investigated using a combination of field mapping, and processing and interpretation of remotely sensed image data. Regional and local relationships are derivable from Thematic Mapper data (30 m resolution), including discrimination and relative age dating of alluvial fans, bedrock mapping, and fault mapping. Aircraft data provide higher spatial resolution over more limited areas. Hypotheses being considered are: (1) the Garlock fault extends east of the intersection; (2) the Garlock fault terminates at the intersection and the Death Valley fault continues southeastward; and (3) the Garlock fault has been offset right laterally by the Death Valley fault which continues to the southeast. Preliminary work indicates that the first hypothesis is invalid. From kinematic considerations, image analysis, and field work the third hypothesis is favored. The projected continuation of the Death Valley zone defines the boundary between the Mojave crustal block and the Basin and Range block. Author


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The project included banding of the Death Valley zone defines the boundary between the Mojave crustal block and the Basin and Range block. Author

DEPARTMENT OF ENERGY, MORGANTOWN, W. VA. Energy Technology Center.


The Second Workshop on Remote Sensing/Lineament Applications for Energy Extraction was held April 23 to 24, 1986, at the Ramada Inn in Morgantown, West Virginia, and was

NTIS HC A07/MF A01

The purpose of the book is threefold: first, to serve as a stimulant in rekindling interest in descriptive geomorphology and landforms analysis at the regional scale; second, to introduce the community of geologists, geographers, and others who analyze the Earth's surficial forms to the practical value of space-acquired remotely sensed data in carrying out their research and applications; and third, to foster more scientific collaboration between geomorphologists who are studying the Earth's landforms and astrogeologists who analyze landforms on other planets and moons in the solar system, thereby strengthening the growing field of comparative planetology. F.M.R.


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NTIS HC A07/MF A01
sponsored and hosted by the US Department of Energy (DOE), Office of Fossil Energy, Morgantown Energy Technology Center. This annual meeting provides a forum for the exchange of information and was attended by 82 individuals who represented industry, private consulting firms, and DOE. Nine papers were presented at the meeting; participants in a panel discussion and an open discussion reviewed and analyzed the information presented. The proceedings have been reproduced from camera-ready manuscripts furnished by the authors. The papers have not been refereed, nor have they been extensively edited. All papers have been processed for inclusion in the Energy Data Base.

DOE


Geologists studied the necessity of retrieving Basic Geology Surveys in Brazil, the contribution of remote sensing in these surveys in Northeast Brazil is studied. The discussion of information extraction techniques from images, based on a proper methodology which, once applied to the semi-arid environment of the Northeast, allowed the mapping of an area of 850 sq km at 1:100,000 scale, depicted the valuable contribution of remote sensing for geological mapping when properly used. The mapped area lies in the Serido Region, being composed by metasediment and metavolcanics of the Serido Group, laid over an Archaean basement known as Caico Complex, as well as by granitic bodies intruded into the supracrustals. Lithologic discriminations and structural features, including new data yet unknown, showed that integrated analyses of varied products of remote sensing, encompassing different techniques of image processing, can give important contribution to the regional geological cartography or even to the semidetail level.


Structural remote sensing analysis techniques for exploration have focussed on mapping of crustal fracture zones which can provide pathways for mineralization as well as permeability for movement and/or accumulation of oil, gas, and geothermal fluids. These analyses have relied heavily on manual lineament analysis of enhanced imagery. These image products contain shadow effects that preferentially enhance or suppress lineaments. This study was conducted to evaluate a digital technique for surface reflectance correction for shadows and subsequent stereo enhancement to provide shadow corrected stereo models for structural geologic exploration. Image products were produced from digital LANDSAT Thematic Mapper (TM) data and a digital elevation model (DEM). The Paiute Ridge quadrangle, Nevada was selected as a test area for the analysis. LANDSAT TM data were registered to the DEM and processed to reduce topographic shadowing effects. A Minnaert reflectance model was used to approximate the topographic lighting effects. This reflectance model provided quantitative evaluation of each pixel in the image and was directly used to create a shadow image. These reflectance values were utilized to remove shadow effects from the TM data to produce the corrected surface reflectance. The DEM was used to stereo enhance the shadow corrected TM image. Fracture orientations determined from the original TM and shadow images show similar bias resulting from solar illumination. This bias was not present in the results from the shadow corrected and the corrected stereopair images, with the best correlation to the trends observed in the field data given by the latter.


During the past several years symmetric three-band (460-, 490-, 520-nm) spectral curvature algorithm (SCA) has demonstrated rather accurate determination of chlorophyll pigment concentration using low-altitude airborne ocean color data. It is shown herein that the in-water asymmetric SCA, when applied to certain recently proposed OCI (NOAA-K and SPOT-3) and OCM (ERS-1) satellite ocean color bands, can adequately recover chlorophyll like pigments. These airborne findings suggest that the proposed new ocean color sensor bands are in general satisfactorily, but not necessarily optimally, positioned to allow space evaluation of the SCA using high-precision atmospherically corrected satellite radiances. The pigment concentration recovery is not as good when existing Coastal Zone Color Scanner bands are used in the SCA. The in-water asymmetric SCA chlorophyll pigment recovery evaluations were performed using (1) airborne laser-induced chlorophyll fluorescence and (2) concurrent passive upwelled radiances. Data from a separate ocean color sensor aboard the aircraft were further used to validate the findings.


New experimental data are presented on the spatial variability of the low-frequency ocean wave spectrum under conditions of a nonstationary wind field. In particular, a series of normalized Wiener spectra of the optical images of various sea conditions are presented along with the Wiener spectra of the radar images of very high (gale) sea. The possible mechanism of the formation of the low-frequency spectra of the waves is examined with reference to the results of the Fourier transform processing of the observational data.

05 OCEANOGRAPHY AND MARINE RESOURCES

Includes sea-surface temperature, ocean bottom surveying imagery, drift rates, sea ice and icebergs, sea state, fish location.
DATA SENSITIVITIES OF SEA ICE DRIFT AND OCEAN STRESS IN NORTH ATLANTIC HIGH LATITUDES
JOHN E. WALSH, BECKY ROSS (Illinois, University, Urbana), DAVID W. PLUMMER, GERALD F. HERMAN, and WILLIAM H. RAYMOND (Wisconsin, University, Madison) Journal of Geophysical Research (ISSN 0148-0227), vol. 91, Oct. 15, 1986, p. 11,657-11,675. refs (Contract NSF DPP-81-18563; NSF DPP-81-19155)
The effects of various data sources on surface stress and sea ice drift in North Atlantic high latitudes are investigated. Drifting buoy reports, surface marine observations, and Tiros-N satellite temperature retrievals for the period between February 25-March 7, 1979 are examined using limited area objective analyses. The planetary boundary layer model of Brown (1981) was employed to compute surface stress from objective analyses of the meteorological data and the sea ice model of Hibler (1979) was utilized for sea ice simulations. The data reveal that the buoy/marine and satellite data can produce significant differences in regional fields of surface stress and ice velocity. It is observed that the buoy/marine data have a greater effect on stress fields than satellite data and objective analyses are degraded by deletion of one or more data types.

ACCURATE MEASUREMENT OF MEAN SEA LEVEL CHANGES BY ALTIMETRIC SATELLITES
G. H. BORN, B. D. TAPLEY, J. C. RIES (Texas, University, Austin), and R. H. STEWART (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; California, University, La Jolla) Journal of Geophysical Research (ISSN 0148-0227), vol. 91, Oct. 15, 1986, p. 11,775-11,782. NASA-supported research. refs
A technique for monitoring changes in global mean sea levels using altimeter data from a well-tracked satellite is examined. The usefulness of this technique is evaluated by analyzing Seasat altimeter data obtained during July-September 1978. The effects of orbit errors, geoid errors, sampling intervals, tides, and atmosphere refraction on the calculation of the mean sea level are investigated. The data reveal that the stability of an altimeter can be determined with an accuracy of + or - 7 cm using globally averaged sea surface height measurements. The application of this procedure to the US/French Ocean Topography Experiment is discussed.

VARIABILITY OF THE PRODUCTIVE HABITAT IN THE EASTERN EQUATORIAL PACIFIC
GENE CARL FELDMAN (NASA, Goddard Space Flight Center, Greenbelt, MD) EOS (ISSN 0096-3941), vol. 67, March 4, 1986, p. 106-108. refs
It is shown that satellite ocean color data can be used to define the spatial extent of the region of enhanced biological production (the productive habitat) in the eastern equatorial Pacific. The degree of interannual variability in the areal extent of the productive habitat and in the estimated primary production of the region is determined. Frequency distributions of satellite-derived pigment concentrations are used to determine whether major changes in phytoplankton biomass have taken place from one period to the next.

COMPARISON BETWEEN SATELLITE IMAGE ADVECTIVE VELOCITIES, DYNAMIC TOPOGRAPHY, AND SURFACE DRIFTER TRAJECTORIES
W. J. EMERY, A. C. THOMAS, M. J. COLLINS (British Columbia, University, Vancouver, Canada), W. R. CRAWFORD, and D. L. MACKAS (Institute of Ocean Sciences, Sidney, Canada) EOS (ISSN 0096-3941), vol. 67, June 3, 1986, p. 498, 499. Research supported by the Department of Fisheries and Oceans and NSERC. refs
An objective technique for the calculation of advective surface velocities from sequential satellite images is presented. Comparisons are made between these image-derived advective velocities and simultaneous measures of the near-surface flow by shallow drogued driftbuoys and 15/110-dB dynamic topography from CTD casts. The dominant feature in all cases is a cyclonic eddy. The good agreement found between these independent measurements of surface velocity suggests that image-derived advective velocities may provide useful representations of the surface current.

CORRELATION BETWEEN TIME- AND DEPTH-RESOLVED SIMULATED LIDAR SIGNALS
In this letter, the results from the analysis of the runs of SALMON code (Punjabi and Venable, 1984) are presented. One important result is that the effective attenuation coefficient at excitation wavelength shows a maximum correlation between depth-resolved and time-resolved signals for variable field of view and variable chlorophyll concentration. The effective attenuation coefficients are related as C(z,L) = about C(z,L). It is also found that the effective velocity of Raman photons decreases as the chlorophyll concentration increases. The incremental Raman normalized fluorescence signal as a function of depth lags behind the one as a function of time.

SIMULATNEOUS OCEAN CROSS SECTION AND RAINFALL MEASUREMENTS FROM SPACE WITH A NADIR-LOOKING RADAR
ROBERT MENEGHINI (NASA, Goddard Space Flight Center, Greenbelt, MD) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0752), vol. 3, Sept. 1986, p. 400-413. refs (Contract NAG5-542)
In the case of a nadir-looking spaceborne or aircraft radar in the presence of rain, the return power corresponding to secondary surface scattering may provide information on the properties of the surface and the precipitation. The object of the study is to evaluate a method for determining simultaneously the rainfall rate and the backscattering coefficient of the surface. The method is based upon the mirror-reflected power, which corresponds to the portion of the incident power scattered from the surface to the precipitation, intercepted by the precipitation, and again returned to the surface where it is scattered a final time back to the antenna.
A87-21367
THE APPLICATION OF GEODETIC RADIO INTERFEROMETRIC SURVEYING TO THE MONITORING OF SEA-LEVEL

The use of VLBI and GPS observations for geodetic surveying is described. The capabilities and functions of the VLBI and the GPS are discussed. The application of the techniques to the calculation of the vertical rates of motion of tide gauges is examined and examples are provided. Consideration is given to polar motion and changes in length of day.

A87-22041
EQUATORIAL INDIAN OCEAN EVAPORATION ESTIMATES FROM OPERATIONAL METEOROLOGICAL SATELLITES AND SOME INFERENCES IN THE CONTEXT OF MONSON ONSET AND ACTIVITY
BABY SIMON and PRANAV S. DESAI (Indian Space Research Organization, Space Applications Centre, Ahmedabad, India) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 37, no. 1-2, Oct. 1986, p. 37-52. refs

A87-23362
THE EFFECT OF HURRICANE GLORIA ON SEA SURFACE TEMPERATURE PATTERNS

A87-23391
MONTH-TO-MONTH VARIABILITY OF OCEAN- ATMOSPHERE LATENT HEAT FLUX AS OBSERVED FROM THE NIMBUS MICROWAVE RADIOMETER

Comparison with in situ measurements shows that the Nimbus/Scanning Multichannel Microwave Radiometer is useful in describing the month-to-month variability of the latent heat flux 'LE' and related parameters during the 1982-1983 El Nino event. The spaceborne measured monthly mean LE was found to be within 30 W/sq m of those derived from ship reports. Absolute accuracy could not be determined, though satellite measurements could extrapolate information on the LE both in space and in time.

A87-23718
A SATELLITE TIME SERIES OF SEA SURFACE TEMPERATURES IN THE EASTERN EQUATORIAL PACIFIC OCEAN, 1982-1986

A87-23719
MESOSCALE HYDROGRAPHIC VARIABILITY IN THE VICINITY OF POINTS CONCEPTION AND ARGUELLO DURING APRIL-MAY 1983 - THE OPUS 1983 EXPERIMENT
LARRY P. ATKINSON (Old Dominion University, Norfolk, VA), KENNETH H. BRINK (Woods Hole Oceanographic Institution, MA), RUSS E. DAVIS (California, University, La Jolla), BURTON H. JONES (Southern California, University, Los Angeles), THERESA PALUSZKIEWICZ (Oregon State University, Corvallis) et al. Journal of Geophysical Research (ISSN 0148-0227), vol. 91, Nov. 15, 1986, p. 12899-12918. refs (Contract NSF OCE-85-11526; NSF OCE-85-06468; NSF OCE-82-13872; NSF OCE-85-07438; NSF OCE-82-13456)

A87-23720
TEMPERATURE-PLANT PIGMENT-OPTICAL RELATIONS IN A RECURRENT OFFSHORE MESOSCALE EDDY NEAR POINT CONCEPTION, CALIFORNIA
JAMES J. SIMPSON, JOSE PELAEZ, LOREN R. HAURY, DAVID WIESsenhaHN (California, University, La Jolla), and CHESTER J. KOBLINSKY (NASA, Goddard Space Flight Center, Greenbelt, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 91, Nov. 15, 1986, p. 12919-12936. Research supported by the University of California and NASA. refs (Contract N00014-86-K-0752) (AD-A176666)

The temperature-plant pigment-optical structure of a mesoscale anticyclonic eddy consistently found in shipboard surveys and satellite-sensed data several hundred kilometers southwest of Point Conception, CA, is described on three different time scales (100-day mesoscale, annual, and several-year). The satellite coastal zone color scanner (CZCS) ocean color imagery detected the near-surface chlorophyll structure of the eddy, but in situ optical and plant pigment data suggest that such imagery does not provide a good estimate of the integrated chlorophyll field of the eddy. The temperature and plant pigment boundaries of the eddy, as determined from two-dimensional gradients of advanced very high resolution radiometer (AVHRR) and CZCS imagery, do not coincide spatially. This and in situ temperature, plant pigment, and optical structure provide additional evidence that some eddy systems in the California Current are not isolated vortex systems but rather continuously entrain waters of nonlocal origin laterally into their upper layers. Within the California Current a ratio of AVHRR/CZCS data is useful for separating inshore from oceanic water masses and following their surface entrainment by offshore vortices. The historical 28-year California Cooperative Oceanic Fisheries Investigations data for the Point Conception region of the California Current and remotely sensed data over this region show that the Point Conception eddy is a recurrent feature in the offshore region. During periods of strong wind forcing, as indicated by maps of sea level pressure, the image advective velocities are stronger and more coherent spatially and appear to cross surface temperature gradients; when winds are weaker, the advective velocities correspond better with the infrared temperature patterns, suggesting the increased contribution of the geostrophic current to the surface flow. Velocities determined from coincident near-surface drogued (5-10 m) buoys, positioned every half hour by internal LORAN-C units in mid-June, show excellent agreement with the image advective velocities. In addition, conductivity, temperature, and depth (CTD) measurements (taken during the buoy tracking) confirm the homogeneity of the upper 10 m, and CTD-derived geostrophic currents are consistent with both buoy and sequential image displacement velocities.

Author
results are consistent with, and may be rationalized by, recent theoretical and experimental results involving a dynamical balance between nonlinear advection and bottom friction, with alternate predominance of one of the two effects.

**A87-23725**  
**MEASUREMENT OF MICROWAVE BACKSCATTERING SIGNATURES OF THE OCEAN SURFACE USING X BAND AND K(A) BAND AIRBORNE SCATTERMETERS**

HARUNOBU MASUKO (Bremen, Universitaet, West Germany), KENICHI OKAMOTO (Ministry of Posts and Telecommunications, Radio Research Laboratory, Kashima, Japan), MASANOBU SHIMADA (National Space Development Agency, Tsukuba Space Center, Japan), and SHUNTARO NIH( (Resources Remote Sensing System, Technology Research Association, Tokyo, Japan)  
refs  
An airborne microwave scatterometer-radiometer system operated in X band and K(a) band was applied to the observations of microwave backscattering signatures of the ocean. The normalized radar cross sections delta exp 0 were measured as combined functions of microwave frequency (10.00 GHz and 34.43 GHz), polarization (HH and VV), incident angle (0-70 deg), azimuth angle (0-360 deg), and wind speed (3.2-17.2 m/s). The azimuth anisotropic signatures for K(a) band are confirmed to be similar to those for X band, and the wind speed dependences are analyzed for each azimuth angle, polarization, and incident angle. For each parameter the behaviors of delta exp 0 for microwave frequencies is shown as compared with the results obtained by other experiments and theories. The effective reflection coefficient, the mean square surface slope, and the two-dimensional wave number spectrum of the short surface waves are estimated from the microwave scattering signatures.

**A87-23854**  
THE USE OF REMOTE SENSING IN ESTIMATING BIOMASS OF FISH TREE AREAS IN THE RICHARD B. RUSSELL LAKE  
WILLIAM A. SHAH, and RICHARD K. MYERS (Clemson University, SC)  
refs  
A multi-sensor approach was developed to study the spatial and temporal variability of biomass of fish tree areas in the Richard B. Russell Lake. A combination of LANDSAT ETM imagery, an airborne microwave radiometer, and an airborne SAR was used to provide information on the spatial and temporal variability of the biomass of fish trees. The results of the study indicate that the biomass of fish trees in the lake is highly variable, with both spatial and temporal patterns.

**A87-24374**  
**VERTICAL STRUCTURE OF THE TEMPERATURE FIELD ABOVE THE NORTH ATLANTIC [O VERTIKAL’NOI STRUKTURE POLIA TEMPERATURY NAD SEVERNOI ATLANTIKOI]**  
V. A. VASILEV and M. A. TRUBINA  
refs  
The study focuses on the vertical structure of the temperature field above the North Atlantic using remote sensing techniques. The results indicate that the temperature field varies significantly with depth, with colder temperatures at greater depths. The study also highlights the role of upwelling and the impact of the Gulf Stream on the temperature structure.

**A87-24376**  
**THE RESULTS OF SEA-SURFACE TEMPERATURE DETERMINATIONS FROM IR AND MICROWAVE MEASUREMENTS ABOARD THE COSMOS-1151 SATELLITE**  
[REZULTATY OPREDENIYA TEMPERATURA POZNOKHNOSTI OKEANA PO IMERNYIAM IZLUCHENIIA V IR- I SVCH-DIAPAZONKH SPECTRA SO SPUTNIKA 'KOSMOS-1151']  
A. K. GORODETSKII, B. G. KUTUZA, M. S. MALKEVICH, and B. Z. PETRENO (AN SSSR, Institut Kosmicheskikh Issledovani and Institut Radiotehniki i Elektroniki, Moscow, USSR)  
Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug, 1986, p. 3-10. In Russian.  
refs  
The study presents the results of sea-surface temperature determinations from infrared (IR) and microwave measurements aboard the Cosmos-1151 satellite. The results are used to understand the spatial and temporal variability of sea-surface temperatures in the study area.
reliable recognition of areas with an IR SST error and those with anomalous values of SSTs as well. Compared with the SST data obtained by ships, the temperatures derived from satellite IR and microwave data were found to exhibit a persistent shift by 1-2 K.

I.S.

A87-24377
EXACT DETERMINATION OF WAVE PARAMETERS FROM THE RESULTS OF FOURIER ANALYSIS OF SEA-SURFACE RADAR IMAGERY [TOCHNOE OPREDELLENIE PARAMETROV VOLN PO DANNYMM FUR’E ANALIZA RADIOIZOBRAZHENII MORSKII POVERKHNOTI]
Iu. V. Bulatov, K. I. Voliak, and V. V. Panenko (AN SSSR, Institut Obshechei Fiziki, Moscow, USSR; Simerofopol’skii Gosudarstvennii Universitet, Simerofopol’, Ukrainian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1986, p. 11-20. In Russian. refs

Side-looking radar images of sea waves were obtained over the Black Sea at several probing azimuths, and the values of the direction and the length of the wave vector were obtained by using coherent optical analysis of the wave images. Methods were developed for the correction of these parameters by accounting for the motions of the radar with respect to the waves and for the turns of the radar antenna. After applying these corrections, the accuracy of the directly determined sea-wave propagation direction and wave vector length improved almost twofold. The accuracy obtained was 2 and 5 deg, respectively. I.S.

A87-24379
POSSIBILITIES OF USING SATELLITE DATA FOR COMPUTATIONS OF THE OCEAN/ATMOSPHERE HEAT EXCHANGE IN THE NEWFOUNDLAND ENERGY-ACTIVE OCEAN ZONE IN WINTER [VOZMOZHNOSTI ISPOL’ZOVANII DANNYKH ISZ DLA RASCHETOV TEPOLOBJEMENIA MEZHDUOKEANOM I ATMOSFEROI V N’UFAUNDELSKOH OKEANOPOBEZI V ZIMNI PERIOD]

The ocean/atmosphere heat-exchange data obtained, in the winter season of 1983-1984, by ships within the Newfoundland energy-active Gulf Stream 'delta' are analyzed and compared with the concurrently obtained satellite scanner images. Synoptic hydrometeorological situations typical for the winter season are inferred from the images, and the characteristics of the ocean-atmosphere heat-exchange energy rates are estimated. The feasibility of using satellite data obtained in the winter season for rapid analysis of heat-exchange processes in the Newfoundland energy-active ocean zone is discussed. I.S.

A87-24748
WIND-WAVE RELATIONSHIP FROM SEASAT RADAR ALTIMETER DATA
P. C. Pandey, R. M. Gaifola, and B. S. Gohil (Indian Space Research Organization, Space Application Centre, Ahmedabad, India) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 37, Nov. 1986, p. 265-289. refs

The paper presents a nonlinear relationship between ocean surface wind at 10 m height (U10) and significant wave height of wind-generated gravity waves, (H1/3)gw, over the open oceans using Seasat radar altimeter data. The data represent a variety of fetches, durations and strength of winds. Concurrent measurement of significant wave height, (H1/3), which may contain a measure of swell and U10 obtained from the processed geophysical data record of the Seasat radar altimeter were used in the analysis. The total wave energy, E(alt), characterized by altimeter H1/3 measurements was compared with the energy of a fully developed sea, E(fd) derived from U10 measurements using the Pierson-Moskowitz model. The criteria E(alt) less than equal to E(fd) was used in data selection to minimize the influence of swell, H(1/3)gw thus obtained was used in a regression in terms of U10 in a second-degree polynomial. Verification with independent radar altimeter data confirmed the validity of the proposed wind-wave model, which could be used for operational wave forecasting. Author

A87-25534#
OZONE IN THE BOUNDARY LAYER OF THE EQUATORIAL PACIFIC OCEAN

Shipboard (about 7 m) ozone measurements made in the equatorial Pacific Ocean between 20 deg N and 17 deg S and 140-160 deg W confirm the existence of a distinct ozone minimum in the vicinity of the equator in the late spring, its decline in the summer, and its absence in autumn. This minimum could not be correlated with high biological activity in surface waters. Coincident aircraft measurements of ozone from near sea surface (50-100 m) to 2 km in altitude were made along 150 deg W at stations at 10 deg N, and 0 deg, 5 deg and 12 deg S in May-June 1984. Aircraft data identified the existence of a distinct ozone maximum between the lifting condensation level (LCL) or cloud base, Z(b), and the trade wind inversion, with ozone mixing ratios amounting to 2.2-2.5 times the ozone levels in the well-mixed subcloud layer. A gradient of decreasing ozone with decreasing altitude extended from the LCL or Z(b) to the near-surface superadiabatic region but did not include it. Author

A87-25543
ATMOSPHERIC CHARACTERISTICS OF THE EQUATORIAL PACIFIC DURING THE 1982-1983 EL NINO, DEDUCED FROM SATELLITE AND AIRCRAFT OBSERVATIONS

A87-25787* Wisconsin Univ., Madison
A CASE STUDY OF GWE SATELLITE DATA IMPACT ON GLA ASSIMILATION ANALYSES OF TWO OCEAN CYCLONES

The effects of the Global Weather Experiment (GWE) data obtained on January 18-20, 1979 on Goddard Laboratory for Atmospheres assimilation analyses of simultaneous cyclones in the western Pacific and Atlantic oceans are examined. The ability of satellite data within assimilation models to determine the baroclinic structures of developing extratropical cyclones is evaluated. The impact of the satellite data on the amplitude and phase of the temperature structure within the storm domain, potential energy, and baroclinic growth rate is studied. The GWE data are compared with Data Systems Test results. It is noted that it is necessary to characterize satellite effects on the baroclinic structure of cyclone waves which degrade numerical weather predictions of cyclogenesis. I.F.

A87-25797* Washington Univ., Seattle
OCEAN SURFACE PRESSURE FIELDS FROM SATELLITE-SENSED WINDS

The University of Washington’s planetary boundary layer model is inverted to use remotely sensed satellite scatterometer-derived surface winds as input to calculate maritime surface pressure fields. The analysis of three different synoptic storm situations is performed using the model and is then compared to conventional National Weather Service analyses. Agreement is good. Isolation

05 OCEANOGRAPHY AND MARINE RESOURCES
of the PBL secondary flow, stratification and thermal wind effects in the model revealed that each may be significant under certain conditions. However, the model shows sensitivity to the thermodynamic features only in a general sense and even a neutral stratification solution gives a good approximation. The high density of the scatterometer data produces mesoscale (hundreds of kilometers) dynamic details, which cannot be confirmed by conventional data at this stage. Author of the scatterometer data produces mesoscale (hundreds of kilometers) dynamic details, which cannot be confirmed by conventional data at this stage. However, the model shows sensitivity to the thermodynamic features only in a general sense and even a neutral stratification solution gives a good approximation. The high density of the scatterometer data produces mesoscale (hundreds of kilometers) dynamic details, which cannot be confirmed by conventional data at this stage.

A87-26531

SPATIAL-STATISTICAL CHARACTERISTICS OF SEA SURFACE FOAM FIELDS (FROM OPTICAL SOUNDING DATA) [PROSTRASTVENNO-STATISTICHESKIE KHAKEKEKSTIKI PENNYKH POLEI NA MORSKII POVERKHNOSti /PO DANNYM OPTICHESKOGO ZONDRIOVANIIA/]

I. V. POKROVSKAIa and E. A. SHARKOV (AN SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1986, p. 18-25. In Russian, refs

Statistically processed aerial photographs of a rough zone of Caspian Sea on October 31, 1981 were used to obtain experimental distributions of the spatial density of foam formations. The density distributions were found to vary from binomial (in the 0.03725 sq km frame) to Gaussian (1.49 sq km frame). It was found that samples of the spatial density field were linearly uncorrelated in any of their orientation relative to the general wave direction.

A87-26970

THE COASTAL ZONE COLOR SCANNER VIEWS THE BISMARCK SEA

E. WOLANSKI (Australian Institute of Marine Science, Townsville, Australia), D. J. CARPENTER (Australian National University, Canberra, Australia), and G. L. PICKARD (Australian Institute of Marine Science, Townsville, Australia; British Columbia, University, Vancouver, Canada) Annales Geophysicae, Series B - Terrestrial and Planetary Physics (ISSN 0755-0685), vol. 4, Feb. 1986, p. 55-82. refs

Coastal Zone Color Scanner images of the Bismarck Sea, obtained by the Nimbus-7 satellite in mid-September 1979, are described and interpreted to understand the likely near surface physical oceanographic phenomena occurring at the time. An atmospheric correction procedure was applied to eliminate the possibility of features being due to local aerosol variation, and an attempt at deriving a chlorophyll distribution image was made. Relative sea surface temperatures accurate to about 0.5 C were obtained. The long wakes and fronts noted, up to 300 km long and oriented roughly north-south, are suggested to be evidence of atmosphere-ocean interaction downwind of mountains and high islands.

A87-27547

AUTOMATED EXTRACTION OF PACK ICE MOTION FROM ADVANCED VERY HIGH RESOLUTION RADIOMETER IMAGERY


Multiple subarea cross correlations have been computed from visible, advanced very high resolution radiometer images of the Beaufort Sea in an automated technique to detect pack ice motion. The computational method is an application of the well-known matched filter and consists of subdividing the first image into a set of subareas and correlating each reference subarea against the appropriate region of the second image. The correlation functions are processed to determine a set of local maxima which define end point vectors of ice displacements from the subarea centers. Resulting velocities agree well with estimates of ice movement obtained by manually measuring invariant ice feature displacements. The velocity fields show the spatial structures of ice motion over scales of 100-500 km with a high degree of pattern consistency and agreement with simple surface wind driving.

A87-27848*

OREGON STATE UNIV., CORVALLIS

FURTHER DEVELOPMENT OF AN IMPROVED ALTIMETER WIND SPEED ALGORITHM


A previous altimeter wind speed retrieval algorithm was developed on the basis of wind speeds in the limited range from about 4 to 14 m/s. In this paper, a new approach which gives a wind speed model function applicable over the range 0 to 21 m/s is used. The method is based on comparing 50 km along-track averages of the altimeter normalized radar cross section measurements with monitoring off-nadir scatterometer wind speed measurements. The scatterometer winds are constructed from 100
km binned measurements of radar cross section and are located approximately 200 km from the satellite subtrack. The new model function agrees very well with earlier versions up to wind speeds of 14 m/s, but differs significantly at higher wind speeds. The relevance of these results to the Geosat altimeter launched in March 1985 is discussed.

A87-27891* R Scan Corp., Minneapolis, Minn.

FORECASTING SEA BREEZE THUNDERSTORMS AT THE KENNEDY SPACE CENTER USING THE PROGNOSTIC THREE-DIMENSIONAL MESOSCALE MODEL (P3DM)


A87-11142

A Prognostic Three-Dimensional Model (P3DM) to produce 1- to 12-h predictions of sea breeze convective (SBC) storms at KSC is described. The P3DM was developed to account for a scale of about 10 km, interactions between surface heat and moisture fluxes, boundary layer convergence, the movement of moisture into cloud formation zones, and alterations in the convective potential in the lower levels of the atmosphere during the diurnal cycle. Initialized with wind, temperature, specific humidity and local water temperature data, the model allows for the distortion of the boundary layer moisture and thermal fields by sea breeze conditions. The results of three simulations of events leading to the onset of SBC storms are presented to demonstrate the model's capabilities, and techniques which may enhance the accuracy of the predictions are discussed. M.S.K.

A87-28437#

DEVELOPMENT AND EXPERIMENT OF AIRBORNE MICROWAVE RAIN-SCATTEROMETER/RADIMETER SYSTEM IV: MICROWAVE BACK-SCATTERING EXPERIMENT OF OCEAN SURFACE


A87-28437

An airborne microwave scatterometer/radiometer system was used to observe microwave backscattering signatures of the ocean. The normalized radar cross sections (NRCS) were measured as combined functions of microwave frequency (10.00 GHz and 34.43 GHz), polarization (HH and VV), incident angle (0-70 deg), azimuth angle (0-360 deg), and wind speed (3.2-17.2 m/sec). The azimuth anisotropic signatures at 34.43 GHz were similar to those at 10.00 GHz. The wind speed dependences were analyzed for each azimuth angle, polarization and incident angle. The behavior of NRCS for microwave frequencies are compared with the results obtained by other studies. Some parameters of the ocean surface, such as the effective reflection coefficient, the mean-square surface slope, and the wave-number spectrum of the short surface waves are estimated from the microwave scattering signatures. Author

A87-28509

INTERPRETATION CHARACTERISTICS OF SPACE PHOTOGRAPHS OF SEA COASTS WITH WIND-INDUCED SURGES [OSOBNENNOSTI DESHIPIROVANIA KOSMICHESE-KIKHI SNIMOKH MORSKHKH POBEREZHII SO SGOONNO-NAGONYMI IAVLENIAMI]

T. V. VERESHCHAKA (Moskovskii Institut Inzhenerov Geodezii, Aerofotozemka i Kartografii, Moscow, USSR), G. F. KRASNOZHOH, and I. E. KURATATOVA (AN SSSR, Institut Vodnykh Problem, Moscow, USSR) Geodezija i Aerofotozemka (ISSN 0536-101X), no. 4, 1986, p. 93-97. In Russian. refs

A method for interpreting satellite photographs of sea coasts with wind-induced surges is described, and results are presented for the North Caspian. Indirect indicators are examined which are significant in connection with the investigation of shoreline changes, flood zones, and other phenomena affecting agriculture and biomass in the coastal region. B.J.

A87-29014

DISTRIBUTION AND BIOMASS OF FUCUS VESICULOSUS L. NEAR A COOLING-WATER EFFLUENT FROM A NUCLEAR POWER PLANT IN THE BALTIIC SEA ESTIMATED BY AERIAL PHOTOGRAPHY


A87-29015

A RADAR OCEAN IMAGING MODEL FOR SMALL TO MODERATE INCIDENCE ANGLES


Based on a first-principles scattering theory applicable to small to moderate incidence angles, a new imaging model for ocean features is proposed. In contrast to the Alpers and Hannings Bragg-based model, the new model incorporates the full ocean wave spectrum, utilizes Hughes' suggested spectral decay rate formula and contains no adjustable parameters. For typical ocean currents, the new model predicts realistic values for L-band cross section modulations and comparable L-band and X-band cross section modulations. These latter results are shown to be due to backscatter from ocean waves that are significantly longer than the Bragg resonant wave. By comparison the Bragg-based imaging model is shown to predict that X-band modulations will be at least one order of magnitude weaker than L-band modulations. Author

A87-29019

ON THE USE OF SYNTHETIC 12-MICRON DATA IN A SPLIT-WINDOW RETRIEVAL OF SEA SURFACE TEMPERATURE FROM AVHRR MEASUREMENTS


A87-30143* California Univ., Los Angeles.

TIDAL HEATING IN AN INTERNAL OCEAN MODEL OF EUROPA

M. N. ROSS and G. SCHUBERT (California, University, Los Angeles) Nature (ISSN 0028-0836), vol. 325, Jan. 8, 1987, p. 133, 134. refs (Contract NSG-7315)

Results are reported from computations of tidal heating processes in a realistic three-layer Europa model featuring an elastic ice lithosphere, an underling inviscid water layer, and an elastic silicate core. The volumic density of the outer two layers were 940 and 1000, respectively, while the European mean density was 3030 kg/ cu m and the total depth of the water layers was 100 km. Calculations of various thermal distributions in the liquid layer, heated tidally by the core, indicate that a decoupled ice lithosphere would be distorted by 23 m at the sub-jovian point, which would correspond with a Love number of 0.26. The tidal heating scenario does not explain the observed recent cracking of Europa's surface, unless the satellite also recently had a significantly more eccentric orbit. M.S.K.
A87-30146

SHEDDING OF AN AGULHAS RING OBSERVED AT SEA
J. R. E. LUTJEHARMS (Council for Scientific and Industrial Research, National Research Institute for Oceanology, Stellenbosch, Republic of South Africa) and A. L. GORDON (Lamont-Doherty Geological Observatory, Palisades, NY) Nature (ISSN 0028-0836), vol. 325, Jan. 8, 1987, p. 138-140. Research supported by the Foundation for Research Development. refs (Contract N00014-84-C-0132)

The Agulhas current flowing northerly into the Atlantic along the southern African coast has the largest volume of water, about 190 million cu m/sec, of any current in the Southern Hemisphere. Meteosat II thermal IR imagery, at 10.5-12.5 microns, of the current in November 1983 showed that the current shed vortex rings as the current encountered Antarctic surface waters. The evolution of the features and the path of the current, supported by surface buoy tracks, is traced over several days. The data indicated that the ring changed from an elliptical to a more stable, circular shape, and had a uniform temperature of about 10 C to a depth of at least 100 m. The ring eventually moved into the south Atlantic and is estimated to contribute up to 7 pct of the energy contributed by the wind to the basin. M.S.K.

A87-30883

OCEAN REMOTE SENSING
ROBERT L. BERNSTEIN (California, University, La Jolla) and PAYSON R. STEVENS IN: Space science and applications: Progress and potential . New York, IEEE Press, 1986, p. 123-131. refs

The areas in which spaceborne remote sensing of the oceans are ready to move from the demonstration project phase to routine utilization are surveyed. Seasat scatterometry furnished data for mapping global ocean current and surface wind patterns. Radar altimetry provides 10 cm accuracy for monitoring the sea surface height to map the vertical distribution of ocean thermal storage. Both passive and active microwave sensors have proven useful for mapping sea ice formation and movement, with active sensors providing 25 m resolution and global orbits allowing tracking ice movement over a 3 day period. Coastal Zone Color Scanner images have identified the boundaries between plankton-heavy regions and open ocean, data which permits fishing fleets to locate the interface where preferred fish schools swim. Landsat imagery has also allowed tracking the drift and dispersion of municipal waste dumped into the ocean. M.S.K.

A87-30900

THE QUANTITATIVE USE OF AIRBORNE THEMATIC MAPPER THERMAL INFRARED DATA
R. D. CALLISON, P. BLAKE, and J. M. ANDERSON (Dundee, University, Scotland) International Journal of Remote Sensing (ISSN 0143-1161), vol. 8, Jan. 1987, p. 113-126. refs

Daedalus Airborne Thematic Mapper (ATM) data, obtained between 12.14 GMT and 13.44 GMT on June 19, 1984 as part of the Natural Environment Research Council’s Airborne MSS-84 campaign, have been used to calculate sea surface temperatures in the western English Channel. Quantitative analyses of the thermal infrared data are discussed with particular reference to boat trials and eddy structures. A method to calculate brightness temperatures and their associated errors is also discussed along with a review of two atmospheric correction procedures for the estimation of sea surface temperatures from thermal infrared data. An apparent asymmetry in the thermal infrared data is considered in the context of the atmospheric correction model used. Results show that the asymmetry can be compensated by using an effective scanner tilt angle. Author

A87-30925

ISLAND WAKES AND HEADLAND EDDIES - A COMPARISON BETWEEN REMOTELY SENSED DATA AND LABORATORY EXPERIMENTS
CHARITHA PATTIARATCHI, ALEC JAMES, and MICHAEL COLLINS (Swansea, University College, Wales) Journal of Geophysical Research (ISSN 0148-0227), vol. 92, Jan. 19, 1987, p. 763-794. NERC-supported research. refs

Island wakes and headland eddies in coastal waters are identified from spaceborne and airborne remotely sensed imagery in the visible wavelengths. The imagery were obtained for the Bristol and English channels, United Kingdom, which are characterized by high tidal currents and levels of turbidity. Suspended matter in the surface waters is used as a passive tracer for the flow features. Scaling parameters (e.g., the Reynolds, Ekman, and Rossby numbers), obtained from the depth-averaged equation of motion, are presented, based upon information on oceanographic conditions at the times of the overpasses. The parameters are compared with data obtained from laboratory model investigations, presented by other experimenters in the published literature. The remotely sensed data demonstrate that in coastal waters with nonuniform obstacles and bathymetry, for a given Ekman number, the flow regimes occur at a lower Rossby number than might be expected from laboratory experiments. In the absence of a method for the accurate determination of the horizontal eddy viscosity, hence the Reynolds number, it is concluded that an ‘‘island wake parameter’’ (Wolanski et al., 1984) should be adopted to describe such features in coastal waters. Author
MULTIANGLE OR MULTIWAVELENGTH TECHNIQUE FOR REMOTE SENSING OF SEA SURFACE TEMPERATURE

WALTER MEYER (Kiel Univ., West Germany) and HARTMUT GRASSL In Ludwig-Maximilians-Universitaet Satellite Measurements of Radiation Budget of the Earth (3rd Symposium) p 155-162 Jul. 1986 Avail: NTIS HC A09/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 37

The multiangle and multiwavelength techniques for sea surface temperature (SST) estimation were compared, using channels 4 and 5 of the Advanced Very High Resolution Radiometer/2 (AVHRR/2) on NOAA-7 centered at 10.8 and 12.0 microns, respectively, for the split window and the multiple angle approach. The influence of horizontal inhomogeneity, modeled by thin, almost invisible cirrus clouds, on the multiangle method was also examined. Results show no improvement in determining SST from measurements at two angles or by combining a two wavelength and a two angle technique at present radiometer noise levels. The influence of almost invisible, thin cirrus clouds on the conical scan is drastic. Normally distributed cirrus clouds (optical thicknesses between 0 and 0.02) add 0.8 K to the mean total error, reaching 1.31 K for polluted skies. Only direct comparison between the measurements of the Along Track Scanning Radiometer and the AVHRR/2 can decide which technique is best. Esa

OCEANOGRAPHY AND MARINE RESOURCES

N87-16492* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ARCHIVAL OF SEASAT-A SATELLITE SCATTEROMETER DATA MERGED WITH IN SITU DATA AT SELECTED, ILLUMINATED SITES OVER THE OCEAN

A large data base of Seasat-A Satellite Scatterometer (SASS) measurements merged with high-quality surface-truth wind, wave, and temperature data has been documented. The data base was developed for all times selected in situ measurement sites were within the SASS footprint. Data were obtained from 42 sites located in the coastal waters of North America, Australia, Western Europe, and Japan and were assembled by correlating the SASS and surface-truth measurements in both time and distance. These data have been archived on a set of nine-track 6250 bpi ASCII coded magnetic tapes, which are available from the National Technical Information Service. Author

N87-16493* Naval Academy, Annapolis, Md.
ANALYSIS OF SURFACE PATTERNS OVER COBB SEAMOUNT USING SYNTHETIC-APERTURE RADAR IMAGERY Final Report, 1985 - 1986
CLARK B. FREISE 27 May 1986 64 p (AD-A171670; USNA-TSPR-136) Avail: NTIS HC A04/MF A01 CSCL 17J

Anomalies in surface wave patterns observed on SEASAT Synthetic-Aperture Radar (SAR) imagery over Cobb Seamount are examined. These anomalies are the surface expression of currents interacting with the seamount. The wavelength of the imaged surface patterns are extracted with advanced SAR digital image processing techniques. Nine of the ten detected wavelengths match the expected spectral wavelength envelope of the internal waves that are calculated using oceanographic data. The results show that the wavelengths of the surface pattern imaged are actually the surface manifestation of internal waves on a subsurface density interface. The internal waves are created by current flow over and around Cobb Seamount disturbing the density interface. Author (GRA)

HYDRODYNAMICS OF INTERNAL SOLITONS AND A COMPARISON OF SIR-A AND SIR-B DATA WITH OCEAN MEASUREMENTS

Large internal solitary waves have been observed by Shuttle SIR-A and SIR-B at locations in the Andaman Sea and the New York Bight. Satellite imagery and oceanographic measurements are used in conjunction with hydrodynamic interaction and electromagnetic scattering models to estimate the expected SAR image intensity modulations associated with the internal waves. There is reasonable agreement between the predicted and observed internal wave signatures. Author

OPERATIONAL WAVE FORECASTING WITH SPACEBORNE SAR: PROSPECTS AND PITFALLS
R. C. BEAL In JPL The Second Spaceborne Imaging Radar Symposium p 107-113 1 Dec. 1986

Measurements collected in the Shuttle Imaging Radar (SIR-B) Extreme Waves Experiment confirm the ability of Synthetic Aperture Radar (SAR) to yield useful estimates of wave directional energy spectra over global scales, at least for shuttle altitudes. However, azimuth fall-off effects tend to be severe for wavelengths shorter than about 100 m in most sea states. Moreover, the azimuth...
fall-off problem becomes increasingly severe as the platform altitude increases beyond 300 km. The most viable solution to the global wave measurements problem may be a low altitude spacecraft containing a combination of both the SAR and the Radar Ocean Wave Spectrometry (ROWS). Such a combination could have a synergy which yield global spectral estimates superior to those of either instrument singly employed. Author

N87-17150*# Environmental Research Inst. of Michigan, Ann Arbor. Radar Science Lab.
IMAGING RADAR CONTRIBUTIONS TO A MAJOR AIR-SEA-ICE INTERACTION STUDY IN THE GREENLAND SEA
ROBERT A. SHUCHMAN In JPL The Second Spaceborne Imaging Radar Symposium p 114-118 1 Dec. 1986
Avail: NTIS HC A10/MF A01 CSCL 06C
By virtue of the Synthetic Aperture Radar (SAR's) imaging capabilities, such as all-weather imaging, relatively high resolution, and large dynamic range of backscatter from SAR ice and open ocean, information on the important marginal ice zone (MIZ) parameters can be derived from the SAR data. Information on ice edge location and condition of ice-edge eddies, for example, can be obtained directly from examination of the imagery as can detection of open water and internal waves. With machine-assisted manual image analysis, estimates of ice concentration, floe size distributions, and ice field motion can also be derived. Full digital analysis, however, is required to obtain gravity wave spectral information and backscatter statistics for ice type discrimination and automated ice concentration algorithms. Author

OBSERVING THE POLAR OCEANS WITH SPACEBORNE RADAR
DREW ROTHROCK In JPL The Second Spaceborne Imaging Radar Symposium p 119-122 1 Dec. 1986
Avail: NTIS HC A10/MF A01 CSCL 06C
The application of spaceborne imaging radar data to polar oceanography and sea ice is explored. Several problems come to mind which are presently ripe with ideas and models, but are in need of new data, SAR data, for any progress to be made. These are the study of the ice mass balance, the ice momentum balance, and the circulation of the Arctic Ocean. These problems are described along with the data which is applicable to them and can be extracted from SAR imagery. Some uses are discussed of these data to explore mesoscale processes which affect the oceans and ice cover. Author

N87-17166# National Space Development Agency, Tokyo (Japan). Earth Observation Center.
SOME RESULTS OF MARINE OBSERVATION SATELLITE (MOS-1) AIRBORNE VERIFICATION EXPERIMENT MULTISPECTRAL ELECTRONIC SELF SCANNING RADIOMETER (MESSR)
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08L
In order to develop distortion correction methods for Marine Observation Satellite-1 (MOS-1) data and the evaluation methods for Earth observation system, airborne verification experiments using three airborne sensors equivalent in performance to MOS-1 sensors were conducted. A multispectral electronic self-scanning radiometer (MESSR) developed by modifying the engineering model of MOS-1 MESSR, which is capable of observing in visible and near-infrared wavelengths with CCD detector elements was tested in an airborne configuration. Results will be used in the spaceborne verification. Author

N87-17184*# Environmental Research Inst. of Michigan, Ann Arbor. Radar Science Lab.
AN INTER-SENSOR COMPARISON OF THE MICROWAVE SIGNATURES OF ARCTIC SEA ICE
(Contract NAGW-334; N000-14-81-C-0295; N000-14-83-C-0404; N000-14-85-K-0200)
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08L
Active and passive microwave and physical properties of Arctic sea ice in the marginal ice zone were measured during the summer. Results of an intercomparison of data acquired by an aircraft synthetic aperture radar, a passive microwave imager and a helicopter-mounted scatterometer indicate that early-to-mid summer sea ice microwave signatures are dominated by snowpack characteristics. Measurements show that the greatest contrast between thin first-year and multyear sea ice occurs when operating actively between 5 and 10 GHz. Significant information about the state of melt of snow and ice is contained in the active and passive microwave signatures. Author

N87-17185*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ACTIVE/PASSIVE MICROWAVE SENSOR COMPARISON OF MIZ-ICE CONCENTRATION ESTIMATES
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08L
Active and passive microwave data collected during the 1984 summer Marginal Ice Zone Experiment in the Fram Strait (MIZEX 84) are used to compare ice concentration estimates derived from synthetic aperture radar (SAR) data to those obtained from passive microwave imagery at several frequencies. The comparison is carried out to evaluate SAR performance against the more established passive microwave technique, and to investigate discrepancies in terms of how ice surface conditions, imaging geometry, and choice of algorithm parameters affect each sensor. Active and passive estimates of ice concentration agree on average to within 12%. Estimates from the multichannel passive microwave data show best agreement with the SAR estimates because the multichannel algorithm effectively accounts for the range in ice floe brightness temperatures observed in the MIZ. Author

N87-17186*# Stanford Univ., Calif. STAR Lab.
AUTOMATED REMOTE SENSING OF SEA ICE USING SYNTHETIC APERTURE RADAR
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08L
Two techniques for automated sea ice tracking: image pyramids (hierarchical correlation) and feature tracking were applied to a pair of SEASAT SAR sea ice images. The results compare well with each other and manually tracked estimates of the ice velocity field. Refinement of the image pyramid technique should include removal of a small number of erroneous velocity vectors using constraints dependent on correlation coefficient, near neighbor
velocities, and velocity gradients. Estimates of sea ice velocity are successfully obtained over limited areas using the boundary segment tracking technique. Refinement of the feature tracking technique should include use of pressure ridge features, constrained search, and relaxation techniques. ESA

N87-17189#  
Canada Centre for Remote Sensing, Ottawa (Ontario). RADARSAT Project Office.

AN OVERVIEW OF OPERATIONAL SAR DATA COLLECTION AND DISSEMINATION PLANS FOR ERS-1 ICE DATA IN CANADA


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The ERS-1 and RADARSAT automated ice information system is described. This Ice Data Integration and Analysis System (IDIAS) will receive data from several sources, including satellite, aircraft, and ship reports, and integrate these onto a standard base map for production of ice forecast products. The satellite data will be received via the station in Gatineau, Quebec and the aircraft data will be downlinked to line-of-sight stations in the Arctic and retransmitted to Ottawa via the Anik-D satellite. The plans for ERS-1 data reception at Gatteau, data integration and product generation from the IDIAS system, and Canadian plans for operational demonstrations of the end-to-end information system within the ERS-1 timeframe are discussed. ESA

N87-17210#  
European Space Agency, Paris (France).

OVERVIEW AND STATUS OF THE ERS-1 PROGRAM


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The ERS-1 satellite system, and the ground segment configuration selected to allow global oceanic mission and delivery of standard products to users within 3 hr from observation are presented. Key features of the ERS-1 program, and information on the Announcement of Opportunity issued to solicit proposals for science investigations and application demonstrations are outlined. ESA

N87-17213#  
City Coll. of the City Univ. of New York.

VERIFICATION RESULTS FOR A TWO-SCALE MODEL OF MICROWAVE BACKSCATTER FROM THE SEA SURFACE


(Contract NAGW-690)

Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The backscatter model of Donelan and Pierson (1986) was adjusted to fit Ku-Band at 13.9 GHz. Data from L to Ka-band are used to test the model. In general, there is no power law. When the wind drops below certain threshold speeds there may be no detectable Bragg backscatter. Saturation may occur at high winds. Results from the Seasat-SASS are used to substantiate the predictions of the model. Suggestions are made for experiments for determining the overall validity of the model are made. ESA

N87-17215#  
Physics and Electronics Lab. TNO, The Hague (Netherlands).

C AND KU-BAND SCATTEROMETER RESULTS FROM THE SCATMOD INTERNAL WAVE EXPERIMENT


Sponsored by a Canadian Defence Research Fellowship

Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Microwave backscatter values were obtained every 12.5 m by aircraft for incidence angles between 17 and 53 deg for 10 internal wave groups in Georgia Strait. Simultaneously, surface measurements (wave slopes, surface current, position, wind) were made. Under all conditions encountered during the 6 day experiment, internal-wave-induced backscatter modulations were measured. The magnitude of the modulations depends strongly on the wind speed. At low wind speed (1.5 to 2 m/sec) high contrasts (20 dB) are observed. At intermediate higher wind speed (6 m/sec) the modulations are much smaller (2 dB) and only weakly dependent on incidence angle. The average contrast in the Ku-band is 1 dB larger than in the C-band. When the magnitude of the modulations is plotted against the first order Bragg wavenumber, a distinct discontinuity occurs at the transition point between C and Ku-band. ESA
Strait north of 78 N were analyzed. Changes in ice concentration, ice floe size distribution, and ice edge position, as well as eddy location and floe motion derived from multitemporal SAR images are investigated in detail, of ocean surface current, wind fields and the bathymetry of the region. The SAR observations show that the MIZ ice cover is highly variable and exhibits rapid dynamic and thermodynamic responses. At the ice edge, during light to moderate wind conditions, the ice drift mirrors the ocean circulation. Radar derived ice kinematics also provide information on ocean eddies beneath the ice in the interior of the MIZ.

**ESTIMATION OF INTERNAL WAVE CURRENTS FROM SAR AND INFRARED SCATTEROMETER IMAGERY**

S. J. HUGHES and B. A. HUGHES


Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+ 20% others)

Models for estimating internal-wave surface currents from SAR and infrared scatterometer images of the ocean surface are presented. Selected SAR images were analyzed using linear hydrodynamic interaction theory and first-order hydrodynamic interaction theory and first-order Bragg scattering, and one IR scatterometer image was analyzed using a semi empirical slope-probability-density model. It is shown that surface features evident in the remote imagery correspond to fluctuations in the measured internal-wave surface current. For both models, it is assumed that the internal-wave current amplitude is much smaller than the propagation speed. Although the wave fields presented have current amplitudes which may be too large for a rigorous application of this linear approximation, the estimated currents compare well with the surface-truth measurements.

**SAR IMAGING OF BOTTOM TOPOGRAPHY IN THE OCEAN: RESULTS FROM AN IMPROVED MODEL**


Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+ 20% others)

A two-space dimensional model, which is applicable to bottom topography and wind, is applied to SeaSat Revs. 762, 957, 1430, and 1473. The model includes the additional modulational effects of a long-wave field on the short Bragg waves, both in the presence of a variable current field and results compared to data. Modulations associated with other radar frequencies are
also calculated under Rev. 762 conditions. It is shown that when the long-wave field effects are included, signature strength does not decrease with increasing radar frequency. The percentage enhancement due to long waves ranges from 7% for L band to 850% for K band.

N87-17299# Environmental Research Inst. of Michigan, Ann Arbor. Radar Science Lab.

AN IMPROVED METHOD FOR THE DETERMINATION OF WATER DEPTH FROM SURFACE WAVE REFRACTION PATTERNS

Avail: NTIS HC A17/ MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A mathematical model for using wave refraction observations to determine water depth from a synthetic aperture radar is presented. The model assumes that the waves are long-crested and obey linear theory, that the currents are negligible, and that there is a single dominant frequency. In principle, under these assumptions, the wavenumber magnitude alone is sufficient to determine the depth using the dispersion relation. However, observations of wavelength and direction do not necessarily obey the basic assumptions which lead to this relation. Therefore, before determining the depth from the dispersion relation, the model filters the basic assumptions which lead to this relation. Therefore, before determining the depth from the dispersion relation, the model filters the data so that it is consistent with the theory. The method is tested against Seasat data. Results include the analysis of the expected error in mapping the depth for a given error in wavelength and the development of an algorithm for objectively analyzing an observed field of wavelength and direction data. This analysis provides a physically consistent field of wavenumber components which is close to the original data but which also obeys the law of conservation of waves and Snell's law.

N87-17335# Marconi Co. Ltd., Chelmsford (England).

SIR-B OBSERVATIONS OF OCEAN WAVES IN THE NE ATLANTIC

Avail: NTIS HC A17/ MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Synthetic-aperture radar (SAR) imagery from Shuttle Imaging Radar was obtained over a deep-water site in the NE Atlantic Ocean. Wave spectra derived from 2 almost orthogonal passes, separated by 6 hr, were compared with simultaneous wave-buoy observations in order to test the predictions of wave-imaging theories. Although azimuth-traveling waves were detected in the second pass, the discrepancy between the SAR and buoy wave spectra is almost an order of magnitude. It is suggested that the velocity-bunching mechanism predicted for azimuth-traveling waves is incorrectly described by the theories.


DERIVING TWO-DIMENSIONAL OCEAN WAVE SPECTRA AND SURFACE HEIGHT MAPS FROM THE SHUTTLE IMAGING RADAR (SIR-B)

Avail: NTIS HC A17/ MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Directional ocean wave spectra were derived from Shuttle Imaging Radar (SIR-B) imagery in regions where nearly simultaneous aircraft-based measurements of the wave spectra were also available as part of the NASA Shuttle Mission 41G experiments. The SIR-B response to a coherently speckled scene is used to estimate the stationary system transfer function in the 15 even terms of an eighth-order two-dimensional polynomial. Surface elevation contours are assigned to SIR-B ocean scenes Fourier filtered using a empirical model of the modulation transfer function calibrated with independent measurements of wave height. The empirical measurements of the wave height distribution are illustrated for a variety of sea states.
The SIR-B Agulhas (Southern Africa) experiment studied the propagation of swell across a major current as a test of technique and to understand the swell-related background to the Giant Wave problem. Image spectra, interpreted as wave spectra, show two distinct wave systems. One, evidently heading upstream, is tentatively identified as a trapped wave.

ESA

Environmental Research Inst. of Michigan, Ann Arbor, Radar Science Lab.

CHARACTERISATION OF INTERNAL WAVE SURFACE PATTERNS ON AIRBORNE SAR IMAGERY
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Techniques to characterize the signatures of surface patterns associated with oceanic international waves which appear on X and L-band, airborne SAR imagery collected during the IIR international wave imaging experiment (SARSEX) are presented. This data set shows that commonly-held conceptions concerning SAR detection of internal waves may need reevaluation. The SAR clearly images azimuth-traveling waves during SARSEX, and in some cases the X-band internal wave signature was stronger than the L-band signature.

ESA

University Catholique de Louvain (Belgium). Lab. de Telecommunications et d'Hyperfrequences.

A TWO-STEP ALGORITHM FOR THE SEPARATE RETRIEVAL OF OCEAN SURFACE AND ATMOSPHERIC PARAMETERS FROM MICROWAVE RADIOMETERS
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

An algorithm for passive microwave remote sensing of the ocean through the atmosphere is proposed. It is based on a contracted form of the radiative transfer equation and on an iterative two-step procedure, such that the extraction of the sea surface parameters and of the atmospheric parameters can be performed separately to a first approximation. Tests on synthetic measurements show that the algorithm is stable, converges rapidly, is independent of the first guess, and works properly in the presence of realistic instrumental errors. The method applies to a rough open sea and will be extended to include foam effects.

ESA

Science Research Council, Chilton (England). Rutherford Appleton Lab.

GATHERING AND PROCESSING A COMPARATIVE DATA SET FOR THE CALIBRATION AND VALIDATION OF ERS-1 DATA PRODUCTS; PREPARATORY WORK AT THE UK-ERS-DC
Avail: NTIS HC A11/MF A01

It is suggested that the main European effort to validate the wind and wave data products of ERS-1 should be concentrated in the North-East Atlantic and Norwegian sea. Also, that conventional oceanographic data gathering techniques using ships and buoys should be augmented with permanently deployed and well validated master stations and airborne instrumentation. The need to sit such stations and altimeter transponders on the ground track arises strongly for the early selection of the location of the ground tracks associated with the initial three-day repeat orbit and for ensuring that any higher repeat cycle is a multiple of three. Work on this subject at the UK-ERS data center is described.

ESA
N87-17369# Institute of Oceanographic Sciences, Wormley (England).


Calibration and validation of ERS-1 wind and wave parameters are discussed using the experience of other oceanographic satellite missions. Major limitations of past efforts appear to be: the limited number of comparisons with near-coincident in-situ platforms, the small dynamic ranges encountered, and the introduction of regional biases by modifications that were heavily weighted to midlatitude, summertime conditions. On the basis of a study of climatological statistics, suitable locations for measuring high wind and wave conditions are suggested.

N87-17370# Centre Oceanologique de Bretagne, Brest (France), Antenne CREO.


Scatterometer measurements over the ocean were analyzed and a model for sigma-zero ($S$) as a function of wind speed, wind direction relative to the beam direction, and incidence angle was derived for ERS-1. Because ERS-1 is yaw-steered: in the space of 00 values of the forward, rear, and central, antennas ($S_1$, $S_2$, $S_3$), the surface of solutions is symmetric with respect to the plan $S_1 = S_2$. The ratios $S_1/S_2$ or $S_2/S_1$ reach 2 distinct maxima for a given wind speed. Two independent methods of calibration of parameters in the C-Band model, using only the wind speed furnished by meteorological fields are obtained. Such methods could be applied to pre-tune the scatterometer in its first months of flight, investigate regional variations, and monitor possible evolutions in the instrument's behavior.

N87-17371# Meteorological Office, Bracknell (England).


A scheme to use satellite derived ocean surface data in environmental sciences is outlined. The scheme involves comparisons between satellite data and ground based measurements, between ground based measurements and numerical models, and between numerical models and satellite data. Each comparison yields vital information, e.g., primary retrieval algorithms, model validation, extension of satellite data validation beyond the regions of surface based networks. Examples of performance characteristics and output products of the UK Meteorological Office global atmospheric and sea state models are given.

N87-17372# Jet Propulsion Lab., California Inst. of Tech., Pasadena. NASA Scatterometer Project.


A method by which satellite and surface measurements can be compared in order to validate satellite wind observations is presented. The regression method requires knowledge of the expected differences (due to atmospheric variability and differing averaging) between perfect satellite and perfect buoy measurements. A model for estimating these differences is described. The regression method is applied to comparisons between Seasat Scatterometer (SASS) and U.S. National Data Buoy Office buoy data. Comparisons indicating a dependence of SASS accuracy on sea-surface temperature are summarized.

N87-17373# GKSS-Forschungszentrum Geesthacht (West Germany).


To demonstrate the capabilities of numerical models for the calibration of satellite derived pressure, wind, and wave-fields, results from numerical simulations are shown and compared to measurements and SMRR-data from NIMBUS 7. The proposed calibration procedure relies on numerical simulation models which themselves are quantitatively calibrated with regionally representative measurements.

N87-17374# Institute of Oceanographic Sciences, Wormley (England).


A method for validation of ERS-1 wind measurements using observations from the Voluntary Observing Ships (VOS) is proposed. The data are available from most ocean regions allowing validation over a wide range of conditions. Although the observations are individually poor quality, data from the North Sea is used to demonstrate that, where sufficient observations exist, a mean value averaged over 1 month and a few hundred kilometers should be accurate to 1 m/sec or better. For absolute calibration a subset of the VOS would be used. For these ships, the wind errors due to poor anemometer exposure must be determined. Results obtained by mounting a high mast in ships' bows are encouraging.

N87-17376# Royal Netherlands Meteorological Inst., De Bilt.


Problems when using wind data from oil or gas production platforms and a proposal for a calibration experiment, using drifting buoys are outlined. The problems with platforms are discussed on the basis of studies on the K13-A platform in the southern North Sea. Drifting buoys being the most cost-effective platforms to obtain data from the high seas, a suggestion is made to deploy a group of drifters measuring wind and, possibly, waves. This could be done by cooperation with the COST-43 organization, which maintains drifting buoy programs in 2 areas.

N87-17377# Centre Oceanologique de Bretagne, Brest (France).


Given the stated accuracy of ERS-1 sensors, the constraints to be dealt with using ships and buoys for a dedicated calibration experiment are discussed. Wave measuring buoys giving directional and non-directional information are available to be used remotely in the open ocean. Wind measurements from ships can be
N87-17380*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. OCEANOGRAPHIC MEASUREMENT CAPABILITIES OF THE NASA P-3 AIRCRAFT ERIK MOLLO-CHRISTENSEN, F. C. JACKSON, E. J. WALSH, and F. HOGE In ESA Proceedings of an ESA Workshop on ERS-1 Wind and Wave Calibration p 111-121 Sep. 1986 Avail: NTIS HC A11/MF A01 CSCL 04B Instrumentation on NASA P3 aircraft available to provide ground truth for ERS-1 is described. The wave sensors include the 36 GHz Surface Contour Radar (SCR), the Ku-band Radar Ocean Wave Spectrometer (ROWS), and the Airborne Oceanographic Lidar. The other sensors include a C-band scatterometer, video camera, radiation thermometer, and AXRTs. The SCR and ROWS directional spectrum measurements are discussed. When planning for an underflight mission, the limited endurance of the aircraft (6 hr) and flight cost (2.7 K$/hr) must be considered. The advantage of the redundancy afforded by the several wave instruments is another important consideration. ESA

N87-17381# Johns Hopkins Univ., Laurel, Md. Applied Physics Lab. A PROCEDURE FOR ESTIMATION OF TWO-DIMENSIONAL OCEAN HEIGHT-VARIANCE SPECTRA FROM SAR IMAGERY FRANK MONALDO In ESA Proceedings of an ESA Workshop on ERS-1 Wind and Wave Calibration p 123-129 Sep. 1986 Avail: NTIS HC A11/MF A01 A step-by-step procedure to convert synthetic aperture radar (SAR) imagery into estimates of the ocean surface wave spectra is outlined. The procedure is based on a linearized version of a model to convert SAR image intensity spectra into either wave slope or height-variance spectra. The procedure is applied to SAR imagery from the SIR-B mission and shown to produce spectra which are highly correlated to two-dimensional spectra measured independently. ESA

N87-17383# Science Research Council, Chilton (England). Rutherford Appleton Lab. MEASUREMENT OF THE DIRECTIONAL SPECTRUM OF OCEAN WAVES USING A CONICALLY-SCANNING RADAR ANDREW ROBERT BIRKS In ESA Proceedings of an ESA Workshop on ERS-1 Wind and Wave Calibration p 135-138 Sep. 1986 Avail: NTIS HC A11/MF A01 It is proposed to use a short-pulse radar altimeter, modified by the addition of a steerable antenna which can scan a cone about nadir, to measure the directional spectrum of ocean waves. The method can be used from either a satellite or aircraft; application from an aircraft is described, having in mind its use in the validation of satellite instruments. Near simultaneous measurements of significant wave height and of the directional wave spectrum are possible with the same instrument, enhancing the value of both measurements. Airborne measurements were made using a 13 GHz radar during a campaign with the NASA CV-900 aircraft. ESA

N87-17384*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. AN OVERVIEW OF THE NSCAT/N-ROSS PROGRAM B. D. MARTIN, MICHAEL H. FREILICH, F. K. LI, and PHILLIP S. CALLAHAN In ESA Proceedings of an ESA Workshop on ERS-1 Wind and Wave Calibration p 143-149 Sep. 1986 Sponsored by NASA Avail: NTIS HC A11/MF A01 CSCL 14B The NASA Scatterometer (NSCAT) to fly on the U.S. Navy Remote Ocean Sensing System (N-ROSS) mission is presented. The overall N-ROSS mission, the NSCAT flight instrument and groundbased data processing/distribution system, and NASA-supported science and verification activities are described. The N-ROSS system is designed to provide measurements of near-surface wind, ocean topography, wave height, sea-surface temperature, and atmospheric water content over the global oceans. The NSCAT is an improved version of the Seasat scatterometer. It will measure near surface vector winds. ESA

N87-17386# Massachusetts Univ., Amherst. INTERSENSOR COMPARISONS FOR VALIDATION OF WIND SPEED MEASUREMENTS FROM ERS-1 ALTIMETER AND SCATTEROMETER CALVIN SWIFT and N. M. MOGNARD In ESA Proceedings of an ESA Workshop on ERS-1 Wind and Wave Calibration p 157-164 Sep. 1986 Avail: NTIS HC A11/MF A01 Discrepancies in wind magnitude data from the three wind sensors on board Seasat, namely the radar altimeter, the scatterometer, and the scanning microwave multifrequency radiometer were analyzed on a global and regional scale for time periods varying from the entire 3-month Seasat period, to a monthly, and a 3-day time scale. The data are analyzed in the Southern Oceans where, during the Seasat lifetime, the highest sea state conditions were found. The algorithms used to process each data set are the official JPL Seasat algorithms. The results point to a more detailed verification activity for future satellite systems such as the SSM/I, NSCAT and the ERS-1 scatterometer. ESA

N87-17389# Max-Planck-lnst. fuer Meteorologie, Hamburg (West Germany). WAVE MODELING ACTIVITIES OF THE WAVE MODELING (WAM) GROUP RELEVANT TO ERS-1 KLAUS HASSELMANN In ESA Proceedings of an ESA Workshop on ERS-1 Wind and Wave Calibration p 173-175 Sep. 1986 Avail: NTIS HC A11/MF A01 A third generation wave model was developed and successfully tested in hindcast studies, in global and regional, deep and shallow water versions. The model will be applied to assimilate wind and wave data from ERS-1. The model will be embedded in a data assimilation system based on a global atmospheric circulation model together with the wave model. The availability of such an operational system at the time of the ERS-1 commissioning phase would greatly assist the calibration and validation of the ERS-1 wind and wave sensors. ESA

to show a more detailed evolution of the bloom within 1979 and to describe the multi-year variability for different seasons.

**N87-18165** Ocean Surface Research, Boulder, Colo.

**SEASAT MICROWAVE ALTIMETER MEASUREMENT OF THE OCEAN GRAVITY WAVE EQUILIBRIUM-RANGE SPECTRAL BEHAVIOR USING FULL-WAVE THEORY**


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A spectral law for the equilibrium region of the waveheight spatial spectrum is derived from the SEASAT altimeter data set. Applicable to the open ocean under all conditions of wave development, the result is a K sup-3.86 power-law dependence rather than the classic-4. This spectral model is established using the specular-point result for backscatter supported by full-wave theory to determine the upper wavenumber limit for the slope spectrum.

**N87-18167** Hamburg Univ. (West Germany). Inst. fuer Organische Chemie.

**ON THE DISCRIMINATION BETWEEN CRUDE OIL SPILLS AND MONOMOLECULAR SEA SLICKS BY AIRBORNE REMOTE SENSORS: TODAY’S POSSIBILITIES AND LIMITATIONS**

H. HUEHNERFUSS, W. ALPERS (Bremen Univ., West Germany), O. FAEST (Swedish Space Corp., Solna), P. A. LANGE (Bundesanstalt fuer Wasserbau, Brunswick, West Germany), A. LOFFET (Belfotop P.v.b.a., Wemmel, Belgium), K. RICHTER (Deutsches Hydrographisches Inst., Hamburg, West Germany), R. C. SCHRIEL (Rijkswaterstaat, Rijswijk, Netherlands), N. SKOU (Technical Univ. of Denmark, Lyngby), and F. WITTE (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) In ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today’s Solutions for Tomorrow’s Information Needs, Volume 3 p 1359-1364 Aug. 1986

Sponsored by the Joint Research Center of the European Community

Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The applicability of X-band real aperture radars (RAR) to the discrimination between crude oil spills and monomolecular sea slicks was investigated. The images obtained by five airborne RAR-systems, flown nearly simultaneously at various angles to the wind direction, were analyzed. The results from flights over four different types of oil spills (Exofsk crude, chocolate mousse, heavy fuel oil, medium fuel oil) and three monomolecular sea slicks (oleyl alcohol, di-(thylenglycol)-mono-isostearyl ether, methyl oleate) show that the advantage of an imaging radar is its unequivocal potential for surveying large sea surfaces. However, RAR systems do not allow a discrimination between oil spills and sea slicks. Therefore, an airborne coastal patrol to identify oil spills reliably must utilize additional sensors.

**N87-18169** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wesseling (West Germany). Inst. for Radio Frequency Technology.

**OIL SLICK DETECTION WITH A SIDELOOKING AIRBORNE RADAR**


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

An experimental inexpensive SLAR operating in X-band is described. It is used for generation of radar imagery from land and sea surfaces with spatial resolution similar to that of future satellite systems. Depending on the application, the SLAR is flown
in different aircraft such as the Cessna 207, Do28 or Do228. The SLAR was employed during the Archimedes 2 project (oil slick detection, qualification and classification in the North Sea). The data collected show the good ability of the SLAR to detect thin oil slicks, 1 micron or less, on the water’s surface. The observed shapes of the slicks are similar to those obtained from a UV and IR sensor.

**Contribution:** Contributions to Oil Spill Detection and Analysis with Radar and Microwave Radiometry, Results of the Archimedes 2 Campaign

K. GRUENER, N. BARTSCH, F. WITTE, H. SCHREIBER, and W. KEYDEL


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set

Oil spill detection with an X-band SLAR, a primitive L-band SAR, and 5 microwave radiometers (1.3 GHz, 32 GHz, 90 GHz) is summarized. The SLAR and the radiometer were installed and flown in the same aircraft. All microwave sensors demonstrate their ability to be used within an oil pollution detection and clearance system. However, especially for the use of microwave radiometry, a sufficient geometrical resolution has to be used in order to estimate thickness and volume of spilled oil with sufficient accuracy. Statistical evaluation methods should be investigated in more detail for radar and for microwave radiometry. It seems possible that the higher statistical moments contain more detailed signature information on the chemical and geometrical quality of observed surface pollution.

**STAR-VUE: A TACTICAL ICE NAVIGATION WORKSTATION**

R. T. LOWRY, S. D. THORNTON, and G. MCAVOY


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set

Downlinks to carry airborne SLAR and SAR data to vessels in Arctic search fields were developed. Data transmitted from the aircraft are automatically recorded on disk. The system allows the recall of current or previous radar imagery for display on a high resolution monitor. With the aid of a trackball, any section of the main image may be displayed in an expanded form. The selected partial display may be output to a hardcopy device if a permanent record is required. The trackball controls all operations, thus no keyboard operations are required. The system is intended to be used by a person with no previous exposure to computer systems.

**STUDY OF OCEAN BOTTOM COUPLING PROCESS USING SATELLITE ALTIMETER DATA**

W. MOON, R. TANG (Texaco Canada Resources Ltd., Calgary, Alberta), and B. H. CHOI (Sung Kyun Kwan Univ., Suwon, South Korea)


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set

The ocean bottom friction law is investigated in the Hudson Bay area of Canada and East China Sea through numerical modeling and correlation of the computed results with Seasat altimeter data. Interactive hydrodynamic modeling is applied in the analysis of the sea surface elevation observed by the Seasat altimeter. Meteorological forcing function is derived by a 2-D grid governed by a set of meteorological relations over the study areas. Since the ocean tides in the study areas introduce large spatial and periodic height variation, the major tidal constituents are included in the computation. Other corrections such as body tide, loading tide, and steric variation of the ocean surface are also included in the processing. The linear bottom friction coefficient estimated over the Hudson Bay area water body is 0.24 cm/sec and the quadratic coupling coefficient over the Hudson Bay area of Canada and East China Sea is 0.0024.

**THE IMPACT OF SATELLITE INFRARED SEA SURFACE TEMPERATURES ON FNOC (FLEET NUMERICAL OCEANOGRAPHY CENTER) OCEAN THERMAL ANALYSES**

Jeffrey D. Hawkins, John M. Harding, Juanita R. Chase, R. M. Clancy, and Bonita L. Samuels

Jun. 1986 44 p

Avail: NTIS A203/MF A01

CSCL 08C

The purpose is to use satellite data to study relationships between discharge of the Yukon River to currents and biologic productivity in the northern Bering Sea. Amended specific objectives are: to develop thermal, sediment and chlorophyll surface maps using thematic mapping (TM) data of the discharge of the Yukon River and the Alaska Coastal Current during the ice free season; to develop a historical model of the distribution of the Yukon River discharge and the Alaska Coastal Current using LANDSAT multispectral scanner (MMS) and NOAA satellite imagery; and to use high resolution TM data to define the surface dynamics of the front between the Alaska Coastal Current and the Bering Shelf/Anadyr Current. LANDSAT MSS and TM, and Advanced Very High Resolution Radiometer (AVHRR) data were recorded during the 1985 ice-free period. The satellite data coincided with shipboard measurements acquired by Inner Self Transfer and Recycling scientists. Circumstances were such, that on July 5 and July 22, all three sensors recorded data that has been registered to a common map projection and map base, then contrast stretched, color composited, and density sliced.

Author
SST data base. These multichannel sea surface temperatures (MCSST), 50,000 to 100,000 per day, far outweigh the spatial and temporal coverage of all in situ reports combined. The MCSST data provide the Expanded Ocean Thermal Structure analysis with highly accurate reports that span the globe. This study reveals that MCSST data significantly add to the mesoscale fronts and eddies mapping effort by tightening up strong frontal gradients and reducing the impact of noisy ship data. Higher resolution analyses are also seen to greatly aid in correctly delineating sharp ocean mesoscale features, as well as take advantages of the MCSST's 8 km by 8 km resolution. GRA

N87-18298# Naval Polar Oceanography Center, Washington, D.C.
EASTERN-WESTERN ARCTIC SEA ICE ANALYSIS, 1985
Nov. 1986 110 p
(AD-A173972; RR-12) Avail: NTIS HC A06/MF A01 CSCL 08L
This publication is the twelfth in a continuing yearly series of Arctic sea ice atlases prepared in the Joint Ice Center at the Naval Polar Oceanography Center, Suitland. The atlas contains weekly charts depicting Northern Hemisphere and Great Lakes ice conditions and extents. The information presented was prepared under operational time constraints principally from satellite imagery supplemented by conventional observations. GRA

N87-18913# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INVESTIGATION OF PHYSICS OF SYNTHETIC APERTURE RADAR IN OCEAN REMOTE SENSING TOWARD 84/86 FIELD EXPERIMENT. VOLUME 1: DATA SUMMARY AND EARLY RESULTS Interim Report, Sep. 1984 - May 1985
OMAR H. SHEMDIN May 1986 160 p
(AD-A174197) Avail: NTIS HC A08/MF A01 CSCL 17I
The mechanisms responsible for SAR imaging of the ocean surface are not adequately understood at present. Conflicting hypotheses have been proposed that remain without valid proof, because of lack of adequate data sets to test these hypotheses. The influence of environmental parameters has prevented extending relationships that were demonstrated under one set of conditions to another beyond the range used in formulating the relationships. GRA

N87-18931# Rhode Island Univ., Kingston. Graduate School for Oceanography.
(AD-A174025) Avail: NTIS HC A08/MF A01 CSCL 04B
A 3-year program of continued research on Arctic haze is planned. The research builds on the accomplishments of the past three years and extends them, with particular emphasis on strengthening the new elemental tracer system, attempting to determine the history of Arctic haze by analyzing the Russian/Norwegian ice core from Nordauslandet, and analyzing aircraft samples from the AGASP II aircraft experiment of spring 1986. The tracer system will be improved in at least three ways: its statistical aspects will be refined, innovative ways of deriving signatures from hard-to-sample areas will be explored, and the tracer power of several noble metals will be determined. From the Nordauslandet core, as many as 100 to 200 samples will be analyzed for trace elements with our new technique developed under DOE sponsorship; we hope to use the results to write both the modern history of Arctic haze and the history of the various regions contributing to it. An extensive set of aircraft samples from AGASP II will be analyzed for trace elements and compared with the results of other investigators. GRA

N87-18970# Institute of Oceanographic Sciences, Wormley (England).
SEASOR CTD SURVEYS DURING FASINEX
R. T. POLLARD, J. F. READ, and J. SMITHERS 1986 108 p
(IOS-230; ETN-87-99137) Avail: NTIS HC A06/MF A01 CSCL 08C
During the Frontal Air Sea Interaction Experiment (FASINEX) 5 SeaSoar runs were carried out, including a creeping line ahead survey of a 120 km x 160 km box spanning the main FASINEX front, a single box 30 km x 90 km circumnavigated 4 times in 3.75 days, and several circuits of the FASINEX mooring array, to measure CTD in the North Atlantic. Track plots using a mixture of Loran and GPS were constructed in near-real-time. ESA
56

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.

A87-20765

SNOW SURVEY FROM METEOROLOGICAL SATELLITE IMAGES IN THE GILIANT MOUNTAIN BASIN IN NORTHWEST CHINA


A87-20951

A THERMAL DEVICE FOR AIRCRAFT MEASUREMENT OF THE SOLID WATER CONTENT OF CLOUDS


refs

A constant temperature probe for the measurement of solid water content of clouds is described. The probe is operated at a temperature of 25°C, and is designed to collect and melt ice particles that impact in an open half-cylinder, the amount of power supplied to the probe being related to the solid water content through its dimensions, etc. Comparisons in a small wind tunnel with values derived from weighings of oil-coated slides suggests that the probe is accurate to about 50 percent, while data from two different aircraft indicate that it performs reliably under flight conditions.

Author

A87-23361

REMOtELY SENSED ALBEDO OF SNOW-COVERED LANDS


A97-23370

SATELLITE RAINFALL RETRIEVAL BY LOGISTIC REGRESSION


A model using logistic regression in which a likelihood function is maximized is described for use in rainfall estimation. The model output is the distribution of rainrate categories from which standard errors can be estimated, and the significance of the covariates can be easily tested. The logistic model is demonstrated with the example of Gate phase 1 data for a scenario for which observations of microwave temperature and fractional rain area are available.

I.S.
06 HYDROLOGY AND WATER MANAGEMENT

A87-23374
REMOTE SENSING OF HYDROLOGICAL VARIABLES FROM THE DMSP MICROWAVE MISSION SENSORS

Characteristics of three meteorological sensors (the SSM/I microwave imager, SSM/T microwave temperature sounder, and SSM/T-2 millimeter wave moisture sounder) of the Defense Meteorological Satellite Program (DMSP) spacecraft of the 1990s are described. Using simulated sensor data, unique retrieval techniques are developed for obtaining water vapor profiles, precipitation, integrated water vapor, cloud liquid water, soil moisture, and surface type. The DMSP microwave mission sensor package is shown to be effective in retrieving these quantities, especially when a multispectral approach is taken. I.S.

A87-23414
ANNUAL AND INTERANNUAL VARIABILITY IN LARGE-SCALE CONVECTION OVER THE EASTERN PACIFIC AND TROPICAL SOUTH AMERICA

A87-23699
ANTARCTICA - MEASURING GLACIER VELOCITY FROM SATELLITE IMAGES

Many Landsat images of Antarctica show distinctive flow and crevasse features in the floating part of ice streams and outlet glaciers immediately below their grounding zones. Some of the features, which move with the glacier or ice stream, remain visible over many years and thus allow time-lapse measurements of ice velocities. Measurements taken from Landsat images of features on Byrd Glacier agree well with detailed ground and aerial observations. The satellite-image technique thus offers a rapid and cost-effective method of obtaining average velocities, to a first order of accuracy, of many ice streams and outlet glaciers near their termini. Author

A87-23808
SATELLITE OBSERVATIONS OF SNOW COVERED AREA IN THE HIGH ATLAS MOUNTAINS OF MOROCCO

A87-23815
PRE-ASSESSMENT FOR LARGE SCALE CIVIL ENGINEERING PROJECTS BY INTEGRATED ANALYSIS WITH THE DATA NUMERICAL TOPOGRAPHY AND REMOTE SENSING

A87-23824
THE UTILITY OF THEMATIC MAPPERS DATA FOR TEMPERATURE MAPPING IN THE GREAT LAKES

The use of Landsat-5 TM thermal IR data to measure and map surface water temperatures in the Great Lakes is studied. Empirical and theoretical modeling approaches for calibrating the TM are described; the calibration was performed using TM data obtained on July 18, 1984 over the Chicago-South Lake Michigan region. The surface water temperature data derived with the quadratic model, cubic model, lookup table, and empirical model are examined and compared. It is observed that all the models effectively estimated the water temperatures and that the cubic model provided a better prediction of the surface reference data than the quadratic or empirical models. I.F.

A87-23825
LANDSAT THEMATIC MAPPER DATA ANALYSIS WITHIN THE SUWANNEE RIVER BASIN

The application of Landsat TM data to land cover classification, delineation of floodplain boundaries, and interpretation of geomorphologic features is evaluated. Landsat-4 TM data for the Suwannee River Basin in Florida are analyzed using image processing software. The initial classification using bands 2, 3, 5, and 7 yielded 16 land cover classes from the 24 spectral classes and the second analysis using bands 1, 3, 4, 6, and 7 produced only 14 land cover classes. The difference in produced land cover classes is attributed to the poor performance of band 6; causes of the poor performance of band 6 are discussed. It is also observed that the TM permits delineation of smaller features than the MSS data and there is good correlation between the vegetation and floodplain boundary. I.F.

A87-23826
REMOTE SENSING OF AQUATIC MACROPHYTE DISTRIBUTION IN UPPER LAKE MARION
JOHN R. JENSEN and BRUCE A. DAVIS (South Carolina, University, Columbia) in: American Congress on Surveying and Mapping and American Society for Photogrammetry and Remote Sensing, Annual Convention, Washington, DC, Mar. 16-21, 1986, Technical Papers. Volume 5. Falls Church, VA, American Congress on Surveying and Mapping and American Society for Photogrammetry and Remote Sensing, 1986, p. 181-189. This study investigates the utility of the Landsat Thematic Mapper sensor system as a source of information on aquatic macrophytes. Analysis of data acquired on May 14th and July 17th, 1984 discriminated predominantly submerged and emerged aquatic vegetation from other land cover classes. Furthermore, innovative extension of spectral clusters resulted in a land cover classification of 41,000 acres in the upper reaches of Lake Marion. Author
A87-2366
LANDSAT THEMATIC MAPPER IMAGES FOR HYDROLOGIC LAND USE AND COVER

A Landsat Thematic Mapper (TM) image of Rochester, N.Y., was visually and digitally analyzed to determine how well 22 hydrologically important land use and cover classes could be identified. Visual interpretations at a scale of 1:70,000 recognized 16 of the classes, while digital classification with a maximum likelihood classifier recognized nine classes with a very high degree of confidence. Bands 3, 4 and 5 provided most of the information for both visual and digital analyses, and would be a sufficient subset of the seven TM bands for either method. Greater land use detail was interpretable through visual analysis because spatial characteristics were included, while the digital analysis recognized more general classes, representing mostly cover differences. Author

A87-25746
VISUALIZATION BY AERIAL THERMOGRAPHY OF HYDRODYNAMIC EXCHANGES BETWEEN THE WATER TABLE, STREAMS AND GRAVEL PITS IN THE RHINE PLAIN NORTH OF STRASBOURG (VISUALIZATION, PAR THERMOGRAPHIE AERIENNE, DES ECHANGES HYDRODYNAMIQUES ENTRE LA NAPPE PHREATIQUE, LES COURS D’EAU ET LES GRAVIERES DANS LA PLAINE DU RHIN AU NORD DE STRASBOURG)
ANDRE DURBEC (Ecole Nationale des Ingenieurs des Travaux Ruraux et des Techniques Sanitaires, Strasbourg, France), P. MUNTZER, and LOTHAIRE ZILLOIX (Strasbourg I, Universite, France) Societe Francaise de Photogrammetrie et de Tele detection, Bulletin (ISSN 0244-6014), no. 102, 1986, p. 25-36. In French. refs

A87-26537
USE OF DECEMBER WAVES IN STUDIES OF WATER BODIES BY METHODS OF MICROWAVE RADIMETRY [OB ISPLOZOVARINII DIAPAZONA DETSITMETROVYKH VOLN DLI ISSLEDOVANIIA AKVATORIY METODAMI SVCH-RADIMETRII]
A. G. GRANKOV and A. M. SHUTKO (AN SSSR, Institut Radiotekhniky i Elektroniki, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1986, p. 78-89. In Russian. refs

The determination of the temperature and salinity of water bodies from remote sensing data on the microwave (30-100 cm) emission from the water surface is described. The analysis takes into account the state of the water surface, including foam, wave formations, and oil film features. Approximate corrections are calculated to estimate the contributions of cosmic radio emission and emission from (or absorption by) the ionosphere at these wavelengths. I.S.

A87-27883
DETECTING AND FORECASTING WESTERN REGION FLASH FLOODS USING SYNTHETIC APERTURE RADAR DATA

A87-28436# DEVELOPMENT AND EXPERIMENT OF AIRBORNE MICROWAVE RAIN-SCATTEROMETER/RADIOMETER SYSTEM. III - RAIN MEASUREMENT AND ITS DATA ANALYSIS
MASAHARU FUJITA, KENICHI OKAMOTO, HARUNOBU MASUKO, SHIN YOSHIIKADO, and KENJI NAKAMURA Radio Research Laboratory, Review (ISSN 0033-801X), vol. 32, June 1986, p. 107-125. In Japanese, with abstract in English. refs

An algorithm for estimating the rain rate using data from dual-frequency radar is presented, along with the results of a simulation of its performance. Rain rate is determined by comparing the power of the radar echoes backscattered from the ocean surface with predicted attenuation. A radiative transfer equation is employed to equate the antenna temperature to the rain rate profile sensed with a scatterometer. Account is taken of the effects of the sea surface temperature on the backscattered signal. The excess antenna temperature at 10 GHz is demonstrated to be proportional to the path-integrated rain rate. M.S.K.

A87-29013
DRAINAGE CHANNEL NETWORK OF THE ARCACHON BASIN USING THEMATIC MAPPER DATA OBTAINED AT HIGH TIDE (RESEAU DES CHENAUX DU BASIN D’ARCACHON ETABLIS PAR DES DONNES THEMATIC MAPPER ACQUISES AHAUTE MAREE)

An attempt was made to produce a drainage channel network chart of the Arcachon Basin (on the French west coast), by using unsupervised classification of Landsat-5 Thematic Mapper data acquired while the basin was completely covered with water. This study shows that satellite data supply information about submarine topography, making it possible to study underwater geomorphology at a certain depth with the data furnished by satellite. Author

A87-30899
MAPPING OF WATER QUALITY IN COASTAL WATERS USING AIRBORNE THEMATIC MAPPER DATA

ATM data from the Swansea Bay, England are utilized in the regression analysis for suspensend sediment concentration, mean grain size of material in suspension, surface salinity, and chlorophyll a. Thematic maps of water quality distributions in the embayment are produced at high tide by using unsupervised classification of Landsat-5 Thematic Mapper data. The thematic maps for the various parameters are compared to sea-truth data; it is observed that the data correlate well. It is concluded that remote sensing is a useful technique for mapping surface water quality in coastal regions. I.F.

N87-15547# HYDROLOGIC MODELS OF LAND SURFACE PROCESSES
Avail: NTIS HC A99/MF A01
The role of soil moisture in climate modeling, particularly those aspects to which remote sensing can make a significant contribution, is reviewed. The main features of models of soil water storage and movement at the macroscale of a representative local volume, the mesoscale of an experimental plot, and the macroscale of a catchment are summarized. Soil moisture modeling in general circulation models is discussed, together with uses of remote sensing in the improvement of such techniques. ESA
from bare soils in these regions is mainly controlled by the depth of the upper layer of dry soil. A useful approximation to the daily evaporation rate can be obtained from a simple relationship between the evaporation and the time since the previous rainfall. Rainfall estimation from satellites must be calibrated against rain gage measurements. The rapid decrease in correlation between rainfalls with increasing grid separation is significant for the interpretation of rain gage and satellite rainfall measurements. Spatial variability in IR radiances must be taken into account where comparing observed surface temperatures with those deduced from Meteosat.

N87-15661#  Institut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).

GROUND WATER-FED LAKES IN THE LIBYAN DESERT: THEIR VARYING AREA AS OBSERVED BY MEANS OF LANDSAT-MSS DATA


Five LANDSAT-MSS images acquired between November 1975 and September 1978 were used to study the temporal variability of the area of 3 small groundwater-fed lakes in the Ibedan Awbari, Libya. The hydrological role of the lakes is described. Mean reflectance of a small image window enclosing each lake is taken as a measure of the lake area. To obtain the mean surface reflectance applying to the spectral region 0.4 to 1.1 microns, radiometric and geometric corrections are applied. Results show that oscillations of the lake area occur which would not be predicted on the basis of current hydrological wisdom applying to this region.


GROUP AGROMET MONITORING PROJECT (GAMP) METHODOLOGY INTEGRATED MAPPING OF RAINFALL, EVAPOTRANSPIRATION, GERMINATION, BIOMASS DEVELOPMENT AND THERMAL INERTIA, BASED ON METEOSAT AND CONVENTIONAL METEOROLOGICAL DATA


Original contains color illustrations

Satellite and conventional meteorological data were integrated to achieve space and time continuous mapping and monitoring of rainfall, evapotranspiration, germination dynamics, and biomass development. Rainfall, evapotranspiration, and biomass mapping results demonstrate the feasibility of the methodology to extend existing sources of agro and hydrometeorological information. The accuracy of rainfall mapping, based on METEOSAT cloud information, is 30%. The accuracy of evapotranspiration mapping, based on METEOSAT ground information, is 0.5 mm (10%). Germination and biomass mapping are based on the latter data. End of season biomass results compare well with field observations. The mapping and analysis of thermal inertia demonstrates the potential of evaluating soil water infiltration immediately after rainfall.
APPLICATION OF REMOTE SENSING IN HYDROLOGY AND WATER RESOURCES [APLICACOES DE SENSORIAMENTO REMOTO EM HIDROLOGIA E RECURSOS HIDRICOS]

EVLYN MARCIA LEAO DE NOVO Sep. 1986 14 p In PORTUGESE Submitted for publication

Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

Possible remote sensing data applications in the areas of hydrology and water resources are discussed. The principal field of activity and the electromagnetic spectrum band most used are analyzed first with research in the available bibliography. Also supplied are some examples of orbital data used to monitor water resources monitors as developed at INPE/MCT.

Author

N87-16382#


RUSSELL G. CONGALTON, RANDALL W. THOMAS, and PAUL J. ZINKE 31 Dec. 1986 15 p

(Contract NAGW-881)

(NASA-CR-180118; NAS 1.26:180118) Avail: NTIS HC A02/MF A01

Work focused on the acquisition of remotely sensed data for the 1985 to 1986 hydrologic year; continuation of the field measurement program; continued acquisition and construction of passive microwave remote sensing instruments; a compilation of data necessary for an initial water balance computation; and participation with the EOS Simultaneity Team in reviewing the data necessary for an initial water balance computation. Feathers River watershed as a possible site for a simultaneity experiment.

B.G.

N87-16383#


An Extension of the Split Window Technique for the Retrieval of Precipitable Water

THOMAS J. KLEESPIES and LARRY M. MCMILLIN 3 Oct. 1986 5 p

(AD-A173008; AFGL-TR-86-0201) Avail: NTIS HC A02/MF A01

CSCL 08H

The split window technique has been demonstrated to be a viable method of removing effects of atmospheric attenuation in order to make a more accurate estimate of surface properties. This technique has also been used to estimate low level water vapor fields. In this paper we make an extension to the split window technique such that it is possible to estimate total precipitable water. The essence of the split window technique is making observations of the earth in two differentially absorbing windows. We extend this technique by making observations in the split window under conditions where the atmospheric contribution to the upwelling radiance is essentially invariant, but the surface contribution changes markedly. Under these conditions it is possible to write a set of simultaneous equations and solve them for the transmittance of the split window, and from that deduce the quantity of the primary absorber, water. The conditions under which this extension is valid basically fall under two categories; that of variation in time, and that of variation in space. Consecutive observations of a land surface from a geosynchronous satellite during the heating cycle of the day would be one example. Another would be observations from either a geosynchronous or polar orbiting satellite of immediately adjacent land and water surfaces with contrasting skin temperatures.

GRA

N87-17223#

Environmental Research Inst. of Michigan, Ann Arbor.

Analysis of Multichannel SAR Data of Spitsbergen


Avail: NTIS HC A09/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Multitemporal aircraft SAR images obtained over Spitsbergen in summer are used to illustrate the application of SAR data to identification and monitoring of features of glaciological interest. Snow cover on bare ground, on glaciers, and on moraines, as well as ice cover on lakes, can be clearly identified. Monitoring the up-glacier retreat of the snowline is also possible. This discrimination is based on relative backscatter signatures, and is shown to depend on the frequency and polarization of the radar wave. Other features such as terminal moraines are discriminated on the basis of topographic expression, which is enhanced with stereo images.

N87-17264#

Helsinki Univ. of Technology, Espoo (Finland). Radio Lab.

Developpement of Algorithms to Retrieve the Water Equivalent of Snow Cover from Satellite Microwave Radiometer Data


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Algorithms to retrieve the water equivalent of snow cover from NIMBUS-7 scanning Multichannel Microwave Radiometer for winters 1978-79 through 1981-82 were tested. Using the best algorithm, the microwave response to snow water equivalent was examined. Substantial short-term and long-term (annual) variations are observed in the response, due to the thermal history of snow. First-order regression lines were fitted to each winter's data.

N87-17314#

Toba Merchant Marine Coll. (Japan).

Estimation of Maximum Snow Volume Distribution Using NOAA-AVHRR Data


Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Snow volume was represented as snow water equivalent value at the maximum stage obtained by combining the extraction of snow-nonsnow boundary mesh from AVHRR images and the degree day method. The maximum snow water equivalent at a certain snow boundary mesh is calculated by the degree day method using daily average air temperature data of the nearest neighbor weather station. The estimated snow water equivalent values are extended to maps covering the whole area of north-east Japan. Case studies show the usefulness of satellite data for yearly monitoring of snow volume distribution which extends over several tens of thousands of square kilometers.
Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Digital snow cover mapping by NOAA/AVHRR to assist snowmelt runoff forecasting from LANDSAT MSS data is discussed. It is shown how remote sensing information from LANDSAT-MSS and NOAA/AVHRR supplement each other. When using coarse spatial sensor resolution, special attention to the area, topography, and amount of snow coverage must be paid. ESA

Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Snow and lake ice melting in a 63,000 sqkm area of the southwestern mountains in Norway was studied by use of cloudfree LANDSAT imagery obtained during the period 1975-83. Results confirm the utility of satellite imagery for water management in remote areas, and confirm that snow cover is the single most important parameter in lake ice melting. ESA

Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 04B

Microwave radiiances that would be measured from satellite borne radiometers were computed as a function of rainfall rates from horizontally finite precipitating clouds containing ice and liquid hydrometeors capped by a layer of nonprecipitating ice that covers the remainder of the footprint. Ice at the top of the precipitating clouds depresses the brightness temperatures which depend on rainfall rates because the ice hydrometeor concentrations are assumed to be related to the rainfall rates at the cloud base. It is also found that the brightness temperatures of footprints partially covered by precipitation cells are a nonlinear function of the rainfall rate averaged over the footprint. Thus the average brightness temperatures depend on the peak rainfall rates and the size of the precipitating cloud. ESA

Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Multispectral LANDSAT images were used to study the area near Hailuoto Island (Finland) where traffic links to the mainland are being considered. The hydrolittoral unit classification depends on the changes in water depth and quality and bottom soil in addition to the growing units on a scale of one or more hectares. Open water classes are affected by water vegetation near shores. The LANDSAT classification agrees well with depth measurements in the hydrolittoral of the Hailuoto area for a depth of 0 to 2.5 m, but in deeper water the classification is not so clear. The use of satellite data before a decision is made is of limited value since political and economic factors are more influential than objective assessments of environmental parameters. ESA

Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The applicability and consistency of a model reflecting relationship between digital spectral data and estuarine chlorophyll-A concentrations were examined. The approach involved collection and laboratory analysis of water quality samples, simultaneous acquisition of airborne multispectral scanner data, and selection of channels and their ratios. Results include prediction of chlorophyll-A for two dates composed of high and low freshwater inflow conditions based on the same wavelength channels and their ratios. ESA

Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The applicability of satellite altimetry to profiling terrain and inland waters was assessed using Seasat data. The data reveal ocean-like returns from lakes, providing direct estimates of surface height, surface waveheight and surface backscatter coefficient, quasi-specular returns from several surface types, giving accurate elevation measurements over areas as small as 180m in diameter, and complex returns with features which correspond to specific surface features. Once retracked, the ocean-like and quasi-specular waveforms can be used to carry out precise and accurate terrain profiling. The minimum range and along-track location of features within the complex returns may also be found. Given accurate independent elevation measurements, such data could be used to calibrate the altimeter range estimates. ESA
The results of the application of remote sensing techniques to water quality studies were evaluated from the point of view of the user. The operational applicability of satellites is presently insufficient for routine observations due to the relatively low passing frequency of suitable systems in combination with the high frequency of unsuitable weather conditions. The present systems, based on passive techniques, provide data on a limited number of water quality parameters, and have an insufficient accuracy. The character of the data (accuracy, parameters) does not justify the cost for data acquisition and data processing. It is proposed to use satellite images for the qualitative study of large scale processes. The flexibility of systems onboard aircraft is promising for project-like research. The research should be more directed toward the application of active remote sensing techniques (lasers).

ESPA
DIGITAL IMAGE MATCHING TECHNIQUES FOR STANDARD PHOTOGRAMMETRIC APPLICATIONS


The paper presents digital image matching techniques for standard applications in photogrammetry, such as aerial triangulation, orthophotomapping or data acquisition for digital surface models. The properties of feature based algorithms for computational stereo are discussed. They consist of three steps: (1) selecting appropriate features in the images, as corners, edges, dark or light spots, using an interest operator; (2) finding corresponding points in the images using a matching procedure, leading to three-dimensional-coordinates of points in object space; and (3) interpolation between these points based on a mathematical model of the surface. This concept, being standard in nonphotogrammetric stereo vision systems contrasts to gray level based correlation techniques and profile-oriented or grid-oriented data acquisition methods common in photogrammetry. The paper shows that the methods can be applied for point transfer in aerial triangulation and high precision measurement of digital surface models, especially if one uses an analytical plotter extended by digital computer. The paper shows that the computed data obtained with computational stereo is comparable to that reached by the human operator allowing a practical implementation of the methods in the near future.

Author

AN INFORMATION PROCESSING SYSTEM FOR INTEGRATION OF DATA FROM REMOTE SENSORS, AERIAL PHOTOGRAVIES AND EXISTING MAPS


A persistent problem in the development and application of aerial photo volume tables has been the need to choose between ground and photo measured data in table construction. Certain statistical assumptions have led to the common belief that ground measured information is the only valid choice. This contention was empirically examined for a previously published data set, and some surprising results were discovered. Bias and precision of stand alone volume predictions from aerial photography were indeed affected by the type of data used, but not necessarily in the manner expected. Practical recommendations for developing and utilizing aerial photo volume tables in a statistically valid manner are presented.

Author

CAPABILITIES FOR SOURCE ASSESSMENT


The capabilities of the Source Assessment System for examining and evaluating imagery and/or cartographic source material for the production of cartographic products, are discussed.

R.R.
The system includes formatted textual data entry, extensive error checking, and viewing capabilities such as real-time video and digital modes, and a roam/zoom function. Gray scale, color, and pseudocolor display enhancements are discussed, and the use of split screen, superposition, and graphic overlay, facilitate visual comparison and change detection. Data entry capabilities include both soft copy graphic data for entering feature attributes, and textual data entry to provide descriptive information. Output capabilities include reports, hard copy graphics and digital data files.

A87-23795
CLASSIFICATION OF MULTIDATE THEMATIC MAPPER DATA

Five level II land cover classifications of Thematic Mapper data were in specific dates: March, July, and November, and two used the combination of all three dates. One of the combined date images was reduced in resolution to 60 M. Each method was classified using the unsupervised clustering algorithm. Comparing these classifications in terms of accuracy showed that swamp, pasture/grassland, and mixed forest were most accurately identified in March; water, marsh, bare soil, coniferous trees, and clearcut areas were most accurately identified in July; and deciduous trees and cropland were most accurately identified in November. There was no significant difference in accuracy between the full and reduced resolution classifications.

A87-23796
THE EFFECT OF TRAINING DATA VARIABILITY ON CLASSIFICATION ACCURACY

The effects of different levels of variance in the training statistics upon the accuracy of digital classifiers are investigated. Four classification algorithms were applied to three digital images using various combinations of spectral classes for training data, and the resulting classifications were digitally compared to a reference image to measure accuracy. When spectral subclasses are combined into land cover classes, it is found that the minimum distance and parallelepiped techniques produced significantly less accurate results, while the Bayesian techniques produced more accurate results. Results also indicate that the Bayesian techniques were more robust than the others when the training data was varied.

However, little has been reported which involves spatially complex images. At the Environmental Remote Sensing Center, University of Wisconsin-Madison, a comprehensive comparison of twenty common spatial edge detection algorithms was conducted on an IBM PC-AT microcomputer. The performance of four of the algorithms is discussed with reference to one low noise and two complex earth resource scenes. It was found that some commonly used techniques have questionable utility for earth resource type images and that careful selection and comparison of various window size and weighting function combinations are necessary to achieve optimal results. A possible method for window size selection is described.

Author

A87-23800
A COGNITIVE MEASURE OF TEXTURE IN IMAGERY

Texture, the frequency and arrangement of tones in an image, is one of the fundamental features (along with tone, shape context, etc.) used in the visual image interpretation process. Various authors have proposed over 30 quantitative measures of texture in imagery to use in automated pattern recognition procedures. However, it is unknown whether the proposed measures of texture model the photo interpreter's cognitive measure. For artificial intelligence implementations, the need to emulate the interpreter's cognitive response to texture becomes very important. This paper presents a method for measuring the cognitive response to texture in imagery. Ten subimages extracted from digitized panchromatic aerial photography were used in an experiment with subjects to measure the dissimilarities in texture among the subimages. Multidimensional scaling was used to convert the dissimilarity estimates to a configuration of perceived texture measurements along a single dimension. A number of the previously proposed quantitative measures of texture were then compared to the cognitive measures.

Author

A87-23802
PHOTOMETRIC FUNCTIONS, REFLECTANCE MAP - TWO TECHNIQUES FOR DETERMINING SURFACE SHAPE AND ORIENTATION FROM IMAGE INTENSITY

Photometric function is a technique using image intensity as a means to obtain slope of a surface from a single photograph. The backbone theory of the technique is that the reflected light intensity from a surface is a function of the surface shape and orientation. The idea was first introduced in the late fifties to map part of the lunar surface. That was the first and the last attempt to use such a method for mapping purposes. In the mid-seventies, Horn (1975) introduced the idea of using a reflectance map to obtain shapes from its shadow. This paper presents the concepts of both photometric function and reflectance maps and their potential applications as well as the possibility of modifying them for mapping purposes.
A87-23809 CARTOGRAPHIC ANALYSIS OF REMOTE SENSING DATA THROUGH LANDSAT MOSAIC SCALING


The use of Landsat controlled mosaics for ratioing and rectification is discussed, and it is suggested that both controlled and uncontrolled photomosaics are valuable tools for mineral resource inventory, analysis and monitoring. It is suggested that the use of radar mosaics will be enhanced by the mass production of mosaics at a scale of 1:250,000 and by the combined usage of ERTS-1 and radar flight strips. A formulation for the relationship between swath width, depression angle, and height above terrain is derived.

A87-23827* Vexcel Corp., Boulder, Colo.

SPACE SHUTTLE RADARGRAMMETRY RESULTS


(Contract NAS7-100)

Preliminary results on the radargrammetric processing of SIR-A and SIR-B data are presented. Radargrammetric processing was applied to images of the Trinity National Forest in Northern California, the islands of Cephalonia, Ithaca, and Sardegna, Mt. Shasta, and Cordon La Grasa, Argentina. The preliminary processing of the SIR-A and SIR-B data has produced digital elevation models, stereo models, and a contour map.

A87-24542 ATLAS OF GEO-SCIENCE ANALYSES OF LANDSAT IMAGERY IN CHINA


A versatile multifunction package, POLYSITE, developed for Goddard's Land Analysis System, is described which simplifies the process of interactively selecting and correcting the sites used to study Landsat TM and MSS images. Image switching between the zoomed and nonzoomed images, color and shape cursor change, and location display, and bit plane erase or color change, are global functions which are active at all times. Local functions possibly include manipulation of intensive study areas, new site definition, mensuration, and new image copying. The program is illustrated with the example of a full TM maser scene of metropolitan Washington, DC.


A87-25587 EFFECT OF SURFACE PROPERTIES ON THE NARROW TO BROADBAND SPECTRAL RELATIONSHIP IN CLEAR SKY SATELLITE OBSERVATIONS R. T. PINKER and J. A. EWING (Maryland, University, College Park) Remote Sensing of Environment (ISSN 0034-4427), vol. 20, Dec. 1986, p. 267-282. refs

Several computational experiments have been conducted to estimate the difference between clear sky spectral narrowband (0.5-0.7 microns) and broadband (0.3-2.5 microns) planetary albedo for three cases of wavelength-independent surface albedo and four cases of surface wavelength-dependent (snow, dry sand, meadow, water) albedo. The spectral interval of (0.5-0.7 microns) was selected to approximate the bulk of the VISSR visible channel on the GOES satellites and Channel 1 of the AVHRR on the NOAA operational satellites. Different atmospheric conditions and solar zenith angles have been simulated. It was demonstrated that the relationship between the spectral narrowband and broadband planetary albedo depends primarily on the assumptions made about the magnitude and wavelength dependence of the surface albedo and less on the atmospheric conditions. Future attempts to parameterize the conversion from narrowband to broadband spectral observations should account for the surface type.


A method is presented for calculating the effective periodicity of a region of an earth surface zone by a system of satellites making observations on both the sunlit and the shaded side of the earth. The method consists of computer-aided sequential construction of multisatellite charts, using a system of vector equations. The method can be applied to complex satellite systems with as many as 100 satellites.


The early operational performance of the SPOT satellite and its image distribution system are summarized. SPOT was injected into an 832 km circular orbit on Feb. 22, 1986 and began transmitting pictures the first day. Operational checkouts were completed by the end of April and by June 60,000 images had been transmitted for storage and distribution by SPOT IMAGE, a government/private company. The images are also distributed through contracting agencies in over 40 countries, and six countries have contracted for direct reception of SPOT images. The main applications thus far have been land use surveying and monitoring.
A second, identical SPOT satellite will be launched in either 1987 or 1988. Improvements planned for the SPOT 3 and 4 satellites are discussed briefly.

M.S.K.

A87-29499

A COMPARATIVE TEST OF PHOTOGRAMMETRICALLY SAMPLED DIGITAL ELEVATION MODELS

Results are presented from tests comparing the techniques and accuracy of several digital terrain elevation models. The studies covered the relationships among the methods of sampling, the features of the approximation function for the elevations, and the accuracy of elevations derived with the respective digital elevation models (DEM). The DEMENTS were tested using data from two sets of aerial photographs of farmland, rugged granite bedrock, forests, urban areas, steep and rugged mountains, hills of moderate height, and smooth terrain. Ground truth data were used to validate the DEM projections. The tests revealed standard error factors of 0.2-0.4 per mile in flying height over level terrain, increasing to about 1-2 per mile in hilly terrain. The percentage of errors in the DEMENTS tested was around 0.5 percent. The photogrammetry queries were found to indicate the error bounds of the projections.

M.S.K.

A87-30127

TERRAIN ANALYSIS FROM DIGITAL PATTERNS IN GEOMORPHOMETRY AND LANDSAT MSS SPECTRAL RESPONSE
STEVEN E. FRANKLIN (Newfoundland, Memorial University, Saint John's, Canada) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 53, Jan. 1987, p. 59-65. refs (Contract NSERC-A-8454)

Digital Landsat multispectral images are used with elevation model variables in high relief terrain analysis. An integrated terrain map from conventional photomorphometric methods (based on aerial photointerpretation) is compared with the results of digital processing methods. The objective is to show that there will be a reasonable correspondence between the analogue and digital mappings, and that data digital methods offer significant advantages in terms of survey reliability, accuracy, and repeatability. Digital patterns in spectral response and geomorphometry are shown to capture those attributes of the surface necessary for classification of landscape units. Classification of the MSS digital patterns showed 85 percent repeated agreement with photomorphic survey methods. Agreement rose up to 75 percent as the MSS data were augmented with the geomorphometric patterns. Maps produced using this enhanced discrimination technique are 70 percent accurate when the classes are weighted by area and compared to the photointerpretation on a pixel-by-pixel basis at field-checked test areas. Greater overall interpretation accuracy might have been obtained with more precise digital class description, greater rigor in the conventional survey, or both.

Author

N87-15590# Centre de Developpement des Techniques Avancees, Alger-Gare (Algeria). THE FUNDAMENTAL PROBLEMS FOR THE ENERGY BALANCE STUDY BY SATELLITE IMAGERY
Avail: NTIS HC A99/MF A01

Models for studying the energy balance at the soil-atmosphere interface are reviewed. Problems to be solved for their application at a regional scale include expression of the dynamic resistances, combination of climatological measurements with satellite data, significance of the output parameters, and using the different scales for the input data. Solutions to problems concerning climatological parameters and the spatial extension of models are outlined.

ESA

N87-15625# Centre National de la Recherche Scientifique, Strasbourg (France). Groupement Scientifique de Teledetection Spatiale. DESIGN OF A DATA BASE SYSTEM FOR INFERRING LAND SURFACE PARAMETERS AND FLUXES FROM SATELLITE RADIANCES
Sponsored by CNRS, CNES, and IBM
Avail: NTIS HC A99/MF A01

A data base system which handles as automatically as possible the satellite images and necessary input data used to study time and space variations of climate processes was designed. The general scheme to infer latent and sensible heat fluxes, ground fluxes, and thermal inertia includes calibration, atmospheric corrections, navigation (geometric corrections) and the models which lead to the requested land surface parameters and fluxes from relocated and renormalized radiances.

ESA

N87-16388# Army Engineer Topographic Labs., Fort Belvoir, Va. SPARSE AREA STEREO MATCHING EXPERIMENT
MICHAEL A. CROMBIE Jul. 1986 34 p (AD-A173601; ETL-0424) Avail: NTIS HC A03/MF A01 CSCL 08B

The algorithm used in this experiment is considered by many to be state-of-the-art for calculating x-parallax over rural regions. Even so, its output must be refined in sparse areas in order to meet accuracy requirements. The major result of this experiment showed that x-parallax should be measured from digital imagery containing no more than 10 line pairs per millimeter. The objective of this report is to find ways to improve the output of the X-parallax front-end processor without using information from other front-end processors, and without drastically revising the algorithm. Two approaches were tested, namely to provide to the processor image data most suitable for rural type matching and to use similar yet less demanding procedures in difficult areas. In the first case, stereo matching was performed with digital pictures containing up to 10 lp/mm of information, and in the second case large correlation windows were used on difficult points. The latter approach was performed with another DIAL program designed to measure corresponding points in a pass point mode.

GRA

N87-16963# Centre National d'Etudes Spatiales, Toulouse (France). Radar Dept. VARAN-S RADAR IMAGE INTERPRETATION
N. LANNELONGUE 30 Aug. 1986 8 p (CNES-CT/DRT/TIT/RL-54-T; ETN-87-98806) Avail: NTIS HC A02/MF A01

Images taken by the VARAN-S side-looking airborne radar were interpreted. During an Arctic campaign a set of data was collected using the VARAN-S. An image covering a 15 km x 24 km zone is presented with a classification of 6 classes. The interpretation is preliminary but seems very promising to obtain quantitative data in an operational way with ERS.

ESA

N87-17116# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Geology Group. ENHANCEMENT OF TIME IMAGES FOR PHOTOINTERPRETATION
A. R. GILLESPIE In its The TIMS Data User's Workshop p 12-24 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 14E

The Thermal Infrared Multispectral Scanner (TIMS) images consist of six channels of data acquired in bands between 8 and 12 microns, thus they contain information about both temperature and emissivity. Scene temperatures are controlled by reflectivity of the surface, but also by its geometry with respect to the Sun,
time of day, and other factors unrelated to composition. Emittance is dependent upon composition alone. Thus the photointerpreter may wish to enhance emittance information selectively. Because thermal emittances in real scenes vary but little, image data tend to be highly correlated along channels. Special image processing is required to make this information available for the photointerpreter. Processing includes noise removal, construction of model emittance images, and construction of false-color pictures enhanced by decorrelation techniques.

Author

N87-17131# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CALCULATION OF DAY AND NIGHT EMITTANCE VALUES
ANNE B. KAHELE In Its The TIMS Data User's Workshop p 67-70 1 Nov. 1986
Avail: NTIS HC A05/MF A01 CSCL 04A
In July 1983, the Thermal Infrared Multispectral Scanner (TIMS) was flown over Death Valley, California on both a midday and predawn flight within a two-day period. The availability of calibrated digital data permitted the calculation of day and night surface temperature and surface spectral emittance. Image processing of the data included panorama correction and calibration to radiance using the on-board black bodies and the measured spectral response of each channel. Scene-dependent isolated-point noise due to bit drops, was located by its relatively discontinuous values and replaced by the average of the surrounding data values. A method was developed in order to separate the spectral and temperature information contained in the TIMS data. Night and day data sets were processed. The TIMS is unique in allowing collection of both spectral emittance and thermal information in digital format with the same airborne scanner. For the first time it was possible to produce day and night emittance images of the same area, coregistered. These data add to an understanding of the physical basis for the discrimination of difference in surface materials afforded by TIMS.

Author

N87-17135# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SECOND SPACEBORNE IMAGING RADAR SYMposium
1 Dec. 1986 223 p Symposium held in Pasadena, Calif., 29-30 Apr. 1986
(Contract NAS7-918)
(NASA-CR-180131; JPL-PUS-86-26; NAS 1.26;180131) Avail: NTIS HC A10/MF A01 CSCL 05B
Summaries of the papers presented at the Second Spaceborne Imaging Radar Symposium are presented. The purpose of the symposium was to present an overview of recent developments in the different scientific and technological fields related to spaceborne imaging radars and to present future international plans.

Author

RADAR SIGNATURE DETERMINATION: TRENDS AND LIMITATIONS
J. A. RICHARDS In JPL The Second Spaceborne Imaging Radar Symposium p 184-190 1 Dec. 1986
Avail: NTIS HC A10/MF A01 CSCL 171
Modelling studies, as means for assessing what could be called radar signatures, are a part of two radar remote sensing research programs with which the author is affiliated. First, at the University of New South Wales, assessment of SIR-B data is being undertaken for a number of purposes including its value in and land geomorphological and geological studies, forest and crop assessment, and mapping. A number of early results have been reported, however modelled images are at an early stage. Secondly, the author recently spent 6 months working on SIR-B infrared forest canopy modelling in the Department of Geography at the University of California, Santa Barbara. Results from this work are outlined.

Author

N87-17164# Michigan Univ., Ann Arbor. Inst. of Environmental Research.
COMPONENTS AND COMPARISONS OF POTENTIAL INFORMATION FROM SEVERAL IMAGING SATELLITES
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
An approach for measuring and comparing the potential information content of multispectral image data, based on sensor system specifications is developed. The method extends beyond the spectral and spatial domains to include the temporal domain, and adds a measure of the information in spatial registration. The total potential information of LANDSAT Thematic Mapper data is found to be the greatest of the systems analyzed, and that of the geostationary Visible Infrared Spin Scan Radiometer (VISSIR) the least. Polar-orbiting Advanced Very High Resolution Radiometer (AVHRR) and Coastal Zone Color Scanner (CZCS) meteorological systems with wide-angle coverage, moderate spatial resolution, and five or six spectral bands rank below the TM but above the LANDSAT MSS and SPOT HRV which are comparable to each other.

ESA

N87-17172# Institut Geographique National, Paris (France).
MONITORING OF LARGE PHENOMENA IN DEVELOPING COUNTRIES THROUGH SATELLITE IMAGERY
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
Intra-annual comparisons between satellite images showing the effects of slowly evolving phenomena such as forest degradation or desert spreading, and intra-annual comparisons between images showing the flooding conditions over large areas are discussed. Trampling and overgrazing around a borehole, and monitoring of Niger river throughout a flooding season are described.

ESA

N87-17174# Zurich Univ. (Switzerland). Dept. of Geography.
SRI LANKA'S SOLUTION TO LAND USE MAPPING AND MONITORING FOR THIRD WORLD COUNTRIES DEVELOPMENT
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
Airphoto interpretation with digitally corrected and enhanced LANDSAT MSS imagery was used for land use mapping in Sri Lanka in the scale of 1:1,000,000. Thematic masking procedures starting from the single classes from the land use map, result in an easy assessment of per class changes, with newly acquired satellite imagery. Thus inventorying the land use and monitoring its changes have become an operational national task of the Center for Remote Sensing of the Sri Lanka Survey Department.

ESA

N87-17176# Software Sciences Ltd., Farnborough (England).
THE DESIGN OF AN INTERNATIONAL DATA CENTRE FOR REMOTE SENSING
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)
An architecture for a worldwide infrastructure to enable effective research, commercial, and national exploitation of remote sensing

A KNOWLEDGE-BASED SOFTWARE ENVIRONMENT FOR THE ANALYSIS OF SPECTROMETER DATA


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A mineral identification expert system for the interpretation of symbolic features extracted from numerical data by sequential heuristic classification is described. Solutions for a given classification become data for the next classification step. In this way the expert system is used to merge numerical data with symbolic knowledge. The prototype expert system distinguishes between various spectral features in mineral samples by interpreting waveforms from a spectroradiometer.

N87-17206# Flinders Univ., Bedford Park (Australia). Dept. of Environment and Planning.

THE FRS-68010: A NEW CONCEPT FOR THE ACQUISITION AND ANALYSIS OF NOAA HRPT DATA


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A concept for a NOAA ground station using an array of yagis instead of tracking antennas is presented. This inexpensive antenna configuration guarantees a sufficient signal to noise ratio for the reliable acquisition of HRPT data of the South Australian coastal waters between 32-36 S and 134-141 E. Data processing is performed by a microprocessor system based on the Motorola 68010. Due to the software being written in C and assembly language, basic image processing operations can be performed in 1 sec. Part of the FRS-68010 is a video display processor storing 4 images of 576 by 448 pixels. The image format is reconfigurable by software yielding up to 64 smaller images which can be represented as a loop movie.

N87-17207# Instituto Nacional de Meteorologia e Geofisica, Lisbon (Portugal).

DIGITAL SATELLITE IMAGERY ACQUISITION AND PROCESSING


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The equipment and organization of a satellite imagery ground station are described. Research concerning calibration, IR radiance to temperature conversion, normalization of VIS image data, geometric corrections, pseudocolor table generation, image enhancement, and classification is summarized.

N87-17229# Canada Centre for Remote Sensing, Ottawa (Ontario).

CANADIAN PLANS FOR OPERATIONAL DEMONSTRATIONS OF SATELLITE IMAGING RADAR APPLICATIONS


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Canadian objectives for the utilization of data from ERS-1, particularly SAR image data, for ocean, ice, and land and resources monitoring are presented. The ERS-1 data will allow suitable preparations and readiness of data handling systems and user capability for exploiting data from Canadian RADARSAT satellite. These efforts will receive support from a radar program based on ground-based and airborne scatterometers, airborne SAR, and data processing and analysis systems.

N87-17239# Vexcell Corp., Boulder, Colo.

USING SECONDARY IMAGE PRODUCTS TO AID IN UNDERSTANDING AND INTERPRETATION OF RADAR IMAGERY


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Radargrammetric exploitation of radar images as single images, stereo pairs, images combined with collateral data from multisensor data sets, and as time series was reviewed. Secondary image products (ortho images, stereo ortho images, slope-effect reduced images, simulated radar images, and false color presentations using image products and synergetic data sets) were designed to satisfy the needs to analyze, predict, and extract information from radar images by bringing the original image closer to the investigator.
**DATA PROCESSING AND DISTRIBUTION SYSTEMS**

**N87-17245#** Arkansas Univ., Fayetteville. Dept. of Electrical Engineering.

HAWAIIAN LAVA FLOWS AND SIR-B RESULTS


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Analysis of SIR-B data is applied to the estimation of sigma zero for basaltic lava flows, the sea, and tropical rain forest. Aerial photo data, ground truth observations, and surface roughness measurements are included. Empirical and theoretical electromagnetic scattering models for sigma zero are considered, allowing that the radar return may not be limited to a simple surface scattering problem. A relative calibration model for the SIR-B data based upon ancillary information about the sea state around Hawaii is proposed.

**N87-17249#** Kanazawa Inst. of Tech. (Japan).

BITEMPORAL ANALYSIS OF THEMATIC MAPPER DATA FOR LAND COVER CLASSIFICATION


(Contract JAP-MIN-OF-ED-60129032)

Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Time-sequence analysis of LANDSAT-5 Thematic Mapper (TM) data was performed for diverse land-cover types in Kanazawa area, Takayama district, Japan. The subscene of TM data in the study site covering 800x800 pixels of 25 m span was extracted from the full scene data. After preprocessing, the gray levels in TM data were classified by the Gaussian Maximum Likelihood classifier, allowing for feature selection. The classification procedure was compared for two seasons, i.e., August and October, in terms of the atmospheric reflectance, and the statistical quantities of the gray levels. Results show that atmospheric reflectance is effective for the bitemporal analysis of TM data for land cover classification.

**N87-17251#** IBM Japan. Tokyo Scientific Center.

EVALUATION OF LANDSAT 5 THEMATIC MAPPING (TM) DATA FOR IMAGE CLUSTERING AND CLASSIFICATION


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Analysis and evaluation on the quality of the LANDSAT-5 Thematic Mapper (TM) data for multispectral image clustering and classification are performed. Data used is the TM test data of Tokyo metropolitan area (Path-107, Row-035) dated November 4, 1984. Map-precision geometric correction is performed and the TM data are resampled to 30 m pixel spacing. Statistical characteristics of seven TM bands are analyzed, then information content is evaluated based on the clustering and supervised image classification. For routine land-cover classification, a concept of training data file is proposed and generated to assure the stability of the classification processes. The results are quantitatively compared with the ground truth data with 10 m spatial accuracy. Results confirm that the classification accuracy can be increased with the improvement of ground resolution of the satellite image data in general.

**N87-17255#** Analytic Sciences Corp., Reading, Mass.

A SYNERGISTIC APPROACH FOR MULTISPECTRAL IMAGE RESTORATION USING REFERENCE IMAGERY


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A synergetic image restoration approach, based on a local multichannel least-squares (LS) modeling technique, is demonstrated on multispectral satellite imagery. This approach differs from more traditional global enhancement techniques by effectively exploiting the local correlation properties of multispectral imagery in order to spatially enhance or reduce noise in individual component images. The LS technique optimally estimates the input image using other spectral bands or image sources as local reference data. The procedure is applied to spatially enhance LANDSAT-D MSS and SPOT multispectral data and to reduce noise levels in LANDSAT-D TM data.

**N87-17267#** Zurich Univ. (Switzerland). Dept. of Geography.

MERGING SPACEBORNE IMAGE DATA OF OPTICAL AND MICROWAVE SENSORS


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Seasat SAR images and LANDSAT TM images were merged with high accuracy by a pixel-to-map transformation. The spatial resolution of 1 pixel was limited to 100 m, due to the grid size of the digital terrain model (DTM) required for the SAR image rectification. Accuracy depends on the grid size of the DTM which should be as fine meshed as possible, preferably on the order of the spatial resolution capability of the sensor being used. Results demonstrate that missing information or incomplete data from optical sensors, due for instance to clouds during the overflight, can be completed by data from microwave sensors. It is suggested that images with clouds taken byographic cameras could be restored after being scanned by a raster device scanner. The procedure could also be applied to meteorological satellite images.

**N87-17269#** INTERA Environmental Consultants Ltd., Calgary (Alberta).

DIGITAL TERRAIN MAPPING WITH STAR-1 SAR DATA


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A program to assess the capability of deriving Digital Terrain Mapping (DTM) products from STAR-1 data, an airborne, digital SAR is outlined. A 500 sq km area was flown over varied terrain, and the resultant stereo images were analyzed on an analytical plotter. The DTM thus derived was used to rectify the imagery. Coronal plots and an ortho-photo-like radar image were derived at a scale of 1:50,000. An error analysis was performed indicating that rms elevation errors less than 30 m can be achieved in a production environment.
DATA PROCESSING AND DISTRIBUTION SYSTEMS

N87-17274#  Bern Univ. (Switzerland). Inst. of Geography. ATMOSPHERIC CORRECTIONS OF NOAA-AVHRR DATA VERIFICATION OF DIFFERENT METHODS BY GROUND TRUTH MEASUREMENTS G. NEJDZLY In ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today's Solutions for Tomorrow's Information Needs, Volume 1 p 677-682 Aug. 1986 Sponsored by the Swiss National Science Foundation. Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+-20% others) Satellite data and precision radiation thermometer radiation temperature measurements carried out from low-altitude airplanes over land and water surfaces were compared. The WINDOW radiation transfer model and several split-window algorithms are tested for their suitability to eliminate the atmospheric effect. It is shown that, if meteorological soundings are available, the influence of the atmosphere can be minimized by using the WINDOW model. For water temperature retrievals over Switzerland, a split-window algorithm is computed using satellite data and compared to published algorithms. ESA

N87-17327#  Purdue Univ., West Lafayette, Ind. School of Electrical Engineering. PARAMETER SPACE TECHNIQUES FOR IMAGE REGISTRATION P. ANUTA and C. MCGILLEM In ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today's Solutions for Tomorrow's Information Needs, Volume 2 p 989-994 Aug. 1986 (Contract NSF ECS-82-15539) Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+-20% others) Three methods using parameter space analysis for image registration are compared. The first is a direct correlation of gray tone image patches. The second is a correlation of edge images derived from the image pair to be registered. The third is the parameter space method in which intersecting line segments are located in the two images. The methods are also tested on LANDSAT multispectral scanner and thematic mapper imagery. It is shown that the performance of the three methods is roughly equivalent for high signal-to-noise ratios but that the parameter space method is more robust at low ratios. ESA

N87-17332#  Indiana State Univ., Terre Haute. IRSAP: AN IMPROVED APPROACH IN PROCESSING REMOTELY SENSED DATA M. P. BISHOP, K. LULLA, and P. MAUSEL In ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today's Solutions for Tomorrow's Information Needs, Volume 2 p 1017-1021 Aug. 1986. Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+-20% others) A software accessing package named Interactive Remote Sensing Applications Package (IRSA4P) was developed to rectify lack of interaction between software which when used together promotes synergism, flexibility, and efficiency for complex analyses in remote sensing/geographical information systems applications. The IRSAP software system is modular in design with menu driven architecture. The software system allows for easy integration of new application programs and software modules with existing system software. Its implementation allows users to process remotely sensed data in one processing environment even when accessed remotely. It is made up of software packages. Consequently, users need not contact programming staff in order to access other software packages, or have previous computer science background in order to process remotely sensed data. ESA

N87-17362#  Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt (West Germany). Inst. fuer Hochfrequenztechnik. X-SAR EXTENDS THE FREQUENCY RANGE OF SHUTTLE IMAGING RADAR W. KEYDEL In ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today's Solutions for Tomorrow's Information Needs, Volume 2 p 1207-1212 Aug. 1986 Avail: NTIS HC A17/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+-20% others) The X-SAR/SIR-C mission is introduced. The mission will be a multifrequency SAR with multipolarization capability. The X-SAR to SIR-C addition extends the frequency range of the whole mission to the upper frequency limit existing today due to physical and technological limits. The experiments cover worldwide very many test areas under the same geometrical, atmospheric and radar technical conditions. The X-SAR development and its application together with SIR-C will strongly impact the future of microwave sensing development with respect to planned future activities like polar platforms, the advanced ERS-1, and the space station. ESA

N87-18155#  Klagenfurt (Austria). Inst. of Geography. LAND SURFACE MODELS AS COLLATERAL DATA IN SATELLITE IMAGE INTERPRETATION M. SEGER and P. MANDL In ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today's Solutions for Tomorrow's Information Needs, Volume 3 p 1281-1286 Aug. 1986. Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+-20% others) An analytic scheme for the human interpretation process of satellite images is proposed. Two types of collateral data are used: ecological and socioeconomic (land use) systems and models; and the differentiation of the real space (topographic and thematic information of the study area). A system of photo pattern features and a system of land surface classes are combined into an interpretation key. This process is optimized by a multiple feasibility checking, concerning interpretation principles as well as the selection of land surface classes oriented to the aim of the regional study. The decision process is described as the application of interpretation rules to delineate and to name photo pattern areas, using also spatial collateral data. An ecologically oriented land surface map was compiled. The categories of collateral knowledge for the interpretation could also be a structural base for export systems. ESA

N87-18157#  Digim (1983). Inc. Montreal (Quebec). SPATIAL REMOTE SENSING TO LAND MANAGEMENT G. ROCHON, T. TOUTIN, S. R. HAJA, and A. LECLERC In ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today's Solutions for Tomorrow's Information Needs, Volume 3 p 1291-1296 Aug. 1986 Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+-20% others) The development of highly automated methods and software for use with high-resolution SPOT satellite imagery and GPS data to obtain digital elevation models (DEM), topographic maps, and basic data for map revision at scales of 1:50 000 and smaller is discussed. Reduction of production costs in the order of 50% for ortho-images and DEMs, and reduction in production delays are expected. The system will offer the possibility of integration of the digital products with remote sensing images from other sources and geographic information systems. ESA
SPECIAL ALGORITHMS USED IN THE PROCESSOR BREADBOARD

The performance data show that high-speed image processing described hardware processing modules, and its performance data are superior with respect to the diversification of subtle differences in density and type of forested areas.

Corresponding data sets from MOMS and LANDSAT TM of parts of the Pantanal Matogrosense (South America) were investigated. The area displays open water bodies as well as dense vegetation of different types. Results of data evaluation show that TM data allow excellent identification of water bodies; MOMS data are superior with respect to the diversification of subtle differences in density and type of forested areas.

Large Format Camera (LFC) positioning accuracy is explored for planimetry and height with respect to strip triangulation and single stereomodel processing. Identification and interpretation of map features, and the map updating capabilities are analyzed in relation to the map standards of a topographic map 1:50,000.

Experiences with digital terrain model generation and orthophoto production are reported. Results show that LFC photographs are superior to all other civilian space imaging systems in terms of spatial resolution, geometric integrity, area coverage, and processing.
DATA PROCESSING AND DISTRIBUTION SYSTEMS

N87-18191# Centro Studi ed Applicazioni in Tecnologia Avanzate, Bari (Italy).

UMUS: A PROJECT FOR USAGE OF LANDSAT MSS AND ANCILLARY DATA IN LAND COVER MAPPING OF LARGE AREAS IN SOUTHERN ITALY
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The problem of producing a land use map at 1:200,000 scale and at a I-II level by using LANDSAT MSS data in a geographical context characterized by spatially complex vegetation and terrain is considered. The procedure is based on the integration of multitemporal satellite images with conventional data (digital terrain model, aerial photos, and existing agricultural inventory data). Management of integrated data sets, the method for sample areas selection, and the use of prior probabilities in the classification process are emphasized. The final map is presented and its accuracy quoted.

N87-18189# Kanazawa Inst. of Tech. (Japan).

AUTOMATIC UPDATE PROCEDURE OF THE DIGITIZED LAND USE MAP USING LANDSAT TM DATA
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The updating procedure of the existing land use map using LANDSAT-5 Thematic Mapper (TM) data is described. The colored land use map at a scale of 1:25,000 was digitized, making use of the raster scanning device. In order to get up-to-date information on land use and land cover types, LANDSAT TM data was classified. The optimum categories in the updating procedure were determined from the detailed interpretation of the classified TM image and the digitized map image. Candidates of the optimum categories are rice fields, urban area, and orchard.

N87-18194# Freiburg Univ. (West Germany), Inst. of Physical Geography.

DETECTION OF A SYNTHETIC BIOCLIMATOLOGICAL MAP BY MEANS OF REMOTE SENSING DATA AND A DIGITAL TERRAIN MODEL USING A CORRELATION APPROACH
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

It is argued that a synthetic bioclimatological map can be developed from remote sensing data and a digital terrain model stored in a geographic information system. This map is created through statistical procedures resulting in so-called stochastic models. Through this method, classical bioclimatological maps can be gathered with high significance.

N87-18212# MacDonald, Dettwiler and Associates Ltd., Richmond (British Columbia).

RESOLVING THE DOPPLER AMBIGUITY FOR SPACEBORNE SYNTHETIC APERTURE RADAR
Sponsored by MacDonald Dettwiler, SPAR Aerospace and the Radar Project Office
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A method for estimating the Doppler centroid directly from the received radar data, during the image formation process, is presented. It is based on measuring the range displacement between individual looks, using image correlation techniques. The algorithm was programmed into the GSAR processor, and encouraging test results obtained.

N87-19787# Instituto de Pesquisas Espacais, Sao Jose dos Campos (Brazil).

EVALUATION OF LANDSAT 4 MSS DATA FOR GEOMORPHOLOGICAL MAPPING IN THE SEMIARID ENVIRONMENT FOR REGIONAL PLANNING PURPOSES: AN INTEGRATED APPROACH (STUDY SITE, THE JUAIZEIRO REGION) M.S. Thesis [AVAMACAO DE DADOS DO LANDSAT-4 PARA O MAPEAMENTO GEOMORFOLOGICO NO SEMI-ARIDO COMO SUPORTE AO PLANEJAMENTO REGIONAL: UMA ABORDAGEM INTEGRADA (AREA-TESTE REGIAO DE JUAIZEIRO-BA)]
TERESA GALLOTTIFLORENZANO Sep. 1986 194 p in PORTUGUESE; ENGLISH summary
(INPE-3984-TDL/236) Avail: NTIS HC A09/MF A01

The utilization of LANDSAT-MSS data is evaluated for geomorphological mapping at 1:100 scale in a semiarid environment for regional planning purposes. An integrated mapping approach was used. The study site is located in northern Bahia State and covers nearly 800 sq. km. An integrated method of qualitative nature, based on the CSIRO system, was used together with an analysis of quantitative parameters: morphometric indexes calculated from topographic maps and soil physicochemical data. The remote sensing products used were panchromatic aerial photography at 1:70 and LANDSAT-MSS data of both dry and wet seasons. The digital data were enhanced and classified using a nonsupervised classification algorithm. A map with geomorphological units was drawn using aerial photography. This map was used afterwards as a basis for the evaluation of LANDSAT-MSS data. The geomorphological units were characterized according to their lithology, geomorphology, soils, vegetation, land use and the environmental morphodynamic type. A great amount of information was obtained from the visual analysis of LANDSAT-MSS data, specially when using the contrast stretched color composite.

Author

N87-19792# Instituto de Pesquisas Espacais, Sao Jose dos Campos (Brazil).

METHODOLOGY FOR THE ELABORATION OF THEMATIC MAPS UTILIZING LANDSAT-TM DATA M.S. Thesis [METODOLOGIA PARA A CONFECAO DE MAPAS TEMATICOS UTILIZANDO DADOS T.M.-LANDSAT]
LUIS ANTONIO DEANDRADE May 1986 133 p in PORTUGUESE; ENGLISH summary
(INPE-3893-TDL/225) Avail: NTIS HC A07/MF A01

A methodology for the elaboration of thematic maps for military use in the scale of 1:100,000 is developed. Techniques of digital processing and visual analysis of remote sensing images were used. The thematic mapper sensor of the LANDSAT Satellite was employed and the selected area of study was Formosa (GO). The analysis of the spectral, spatial and temporal attributes of digital and photographic paper images of the LANDSAT Thematic Mapper helped by ancillary data and ground observations of surface characteristics constitute the framework. Four thematic products
8 INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

A87-196547 Reading Univ. (England).

INSTRUMENTATION FOR OPTICAL REMOTE SENSING FROM SPACE; PROCEEDINGS OF THE MEETING, CANNES, FRANCE, NOVEMBER 27-29, 1985

JOHN S. SEELEY, ED. (Reading, University, England), JOHN W. LEAR, ED., SIDNEY L. RUSSAK, ED. (Martin Marietta Corp., Denver, CO), and ANDRE MONFILS, ED. (Liege, Universite, Belgium) Meeting organized by SPIE and Association Nationale de la Recherche Technique; Sponsored by CNES, NASA, ESA, et al. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings Volume 589), 1986, 258 p. For individual items see A87-19648 to A87-19676.

(SPIE-589)

Papers are presented on such topics as the development of the Imaging Spectrometer for Shuttle and space platform applications; the in-flight calibration of pushbroom remote sensing instruments for the SPOT program; buttable detector arrays for 1.55-1.7 micron imaging; the design of the Improved Stratospheric and Mesospheric Sounder on the Upper Atmosphere Research Satellite; and SAGE II design and in-orbit performance. Consideration is also given to the Shuttle Imaging Radar-B/C instruments; the Venus Radar Mapper multimode radar system design; various ISO instruments (ISOCAM, ISOPHOT, and SWS and LWS); and instrumentation for the Space Infrared Telescope Facility.

B.J.

A87-19652 IN FLIGHT CALIBRATION OF PUSH BROOM REMOTE SENSING INSTRUMENTS


The calibration procedures and onboard calibration devices for the SPOT system are described. Tests show that the specification of 10 percent for absolute calibration accuracy and 3 percent for interband calibration accuracy should be satisfied, and better performance is expected. Attention is given to the HRV calibration.

B.J.

A87-19655 IMPROVED MULTISPECTRAL EARTH IMAGING FROM SPACE USING ELECTRONIC IMAGE ALIGNMENT


A scheme for simplifying the design of CCD-based multispectral pushbroom scanners is presented. A new type of real-time signal processor permits registration of the images in the various spectral bands to + or - 0.1 pixel even though the system is mechanically aligned to only + or - 8 pixels. This permits design flexibility and cost reduction in the sensor optical system. The same signal processing can also correct for earth rotation skew and platform attitude errors at the same time, thereby simplifying the archiving and use of the data. An operational land observing system design that uses these ideas is described.

Author

A87-19660 THE ALONG TRACK SCANNING RADIOMETER (ATSR) FOR ERS-1


The ATSR is an infrared imaging radiometer which has been selected to fly aboard the ESA Remote Sensing Satellite No. 1 (ERS1) with the specific objective of accurately determining global Sea Surface Temperature (SST). Novel features, including the technique of 'along track' scanning, a closed Stirling cycle cooler, and the precision on-board blackbodies are described. Instrument subsystems are identified and their design trade-offs discussed.

Author

A87-20672 EVALUATION OF THE MID-INFRARED (1.45 TO 2.0 MICRONS) WITH A BLACK-AND-WHITE INFRARED VIDEO CAMERA

J. H. EVERITT, D. E. ESCOBAR, P. R. NIXON (USDA, Agricultural Research Service, Weslaco, TX), C. H. BLAZQUEZ (Florida, University, Lake Alfred), and M. A. HUSSEY (Texas A & M University, Weslaco) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 52, Oct. 1986, p. 1655-1660. refs

A 0.9-2.2-micron sensitive B&W IR video camera, filtered to record radiation in the 1.45-2.0-micron water absorption region, was evaluated as a potential tool for remote-sensing. Imagery obtained in the laboratory of Peperomia obtusifolia A. Dietr. leaves successfully demonstrated the influence of its unusual internal leaf structure on its 1.45-2.0-micron absorption. Ground-based field video recordings of the succulent prickly pear (Opuntia lindheimeri Engelm.) showed the influence of its high water content on its 1.45-2.0-micron absorption. The camera provided acceptable airborne imagery that detected severely drought-stressed grass from lightly stressed grass. These results demonstrated that a video camera with sensitivity at 1.45-2.0 microns has considerable potential as an applied remote-sensing tool.

Author

A87-20795 PROPOSED DESIGN OF AN IMAGING SPECTROPOLARIMETER/PHOTOMETER FOR REMOTE SENSING OF EARTH RESOURCES

WALTER G. EGAN (Lamont-Doherty Geological Observatory, Palisades, NY) Optical Engineering (ISSN 0091-3286), vol. 25, Oct. 1986, p. 1155-1159. refs

A design is presented for an imaging spectropolarimeter/photometer based on the Landsat multispectral scanner (MSS) for the wavelength range of 0.5 to 1.1 microns. The proposed scanner has essentially the same wavelength sensitivity, field of view, and scanning parameters of the original MSS except for the duplication of sensing and data systems for the detection of the amount of plane polarization. A unique nonpolarizing (i.e., polarization-compensated) scanning system is described, as well as a nonpolarizing beam splitter.

Author
A87-20961*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INSTRUMENT CHARACTERIZATION FOR THE DETECTION OF LONG-TERM CHANGES IN STRATOSPHERIC OZONE - AN ANALYSIS OF THE SBUV/2 RADIOMETER

The scientific objective of unambiguously detecting subtle global trends in upper stratospheric ozone requires that one maintains a thorough understanding of the satellite-based remote sensors intended for this task. The instrument now in use for long term ozone monitoring is the SBUV/2 being flown on NOAA operational satellites. A critical activity in the data interpretation involves separating small changes in measurement sensitivity from true atmospheric variability. By defining the specific issues that must be addressed and presenting results derived early in the mission of the first SBUV/2 flight model, this work serves as a guide to the instrument investigations that are essential in the attempt to detect long-term changes in the ozone layer.

Author

A87-21094
THE SPOT SATELLITES - FROM SPOT 1 TO SPOT 4

Starting with SPOT 1, the paper describes successivly its sun-synchronous orbit, the 2 identical imaging instruments, and the other subsystems such as the onboard tape recorders, the telemetry package, the stabilization equipment, etc. Special emphasis is given to the technological innovations, in SPOT's 1 and 2, with respect to the first-generation satellites represented by the three first spacecraft of the Landsat series. The paper then details the improvements carried out on the design of the 3rd and 4th models.

Author

A87-22025
THE SEU RISK ASSESSMENT OF Z80A, 8086 AND 80C86 MICROPROCESSORS INTENDED FOR USE IN A LOW ALTITUDE POLAR ORBIT

This paper presents the results of a test and analysis carried out in support of an Earth Resources Satellite project in order to provide a quantitative SEU risk assessment for certain microprocessor based subsystems. The key features of the program were the low cost and comparative simplicity of the test techniques which, nevertheless, provided sufficient data for a quantitative risk assessment using the CREME suite of programs.

Author

A87-22476#
EFFECTS OF A DOWNSTREAM DISTURBANCE ON THE STRUCTURE OF A TURBULENT PLANE MIXING LAYER

The responses of the mixing layer in the regions upstream and downstream of a two-dimensional disturbance are studied using flow visualization and laser Doppler velocimetry. The disturbance is generated by a two-dimensional pitching airfoil located downstream of the splitter plate trailing edge. It is observed that at low forcing frequencies the region upstream of the disturbance is unaffected and the shear layer growth rate downstream is increased; for high forcing frequencies the flow structure in the upstream region is modified and the growth rate in the downstream area is unchanged. It is proposed that a coupling mechanism may cause these changes in the shear layer.

I.F.

A87-22556*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

EARTH OBSERVING SYSTEM - THE EARTH RESEARCH SYSTEM OF THE 1990'S

The Earth Observing Systems' objective of comprehensively studying the earth's change leads to an array of technological and implementational challenges. Included in those challenges are in the in-orbit maintenance of fifty instruments through periodic servicing and the development of an international ground information system which permits rapid access to high quality data. The paper describes these challenges and also discusses potential contributions from international and USA agencies, mission design and payload groupings strategies, as well as design approaches to the spacecraft itself.

Author

A87-23390
NIMBUS-7 SMMR MULTISPECTRAL PASSIVE MICROWAVE CORRELATIONS WITH AN ANTECEDENT PRECIPITATION INDEX

A correlation analysis between Nimbus 7 Scanning Multichannel Microwave Radiometer passive microwave brightness temperatures (from between October 1978 and November 1979) and an antecedent precipitation index, API, (calculated from precipitation observations) was performed to infer surface soil moisture. Three transformations of vertical and horizontal components of the polarized brightness temperatures were used to represent various aspects of terrain, vegetation, and atmospheric conditions. Results indicate that the modification difference transform had the highest correlation coefficient with the API, though the values were insignificantly different from the other transform values indicating that any one of the transforms could be used to estimate the API over bare soil without the need for an additional surface temperature estimate.

R.R.

A87-23419* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

IDEAS FOR A FUTURE EARTH OBSERVING SYSTEM FROM GEOSYNCHRONOUS ORBIT

Uses for the proposed geosynchronous platform are described. The geosynchronous satellite could provide good spatial and temporal resolution, a larger field-of-view, easier calibration, stereography, and data relay. The limitations of the platform are discussed. The applications of the geosynchronous platform to meteorology, earth surveying, and oceanography are examined.

I.F.
A87-23546* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SAM II MEASUREMENTS OF ANTARCTIC PSC'S AND AEROSOLS


(Contract NAS7-17022)

Measurements by the SAM II satellite instrument show that polar stratospheric clouds (PSC's) are a regular feature of the austral winter season in either nonvolcanically or volcanically disturbed periods. The tops of these clouds are observed above 20 km in early winter and descend in altitude over the course of the season to heights near 15 km in mid September. Typically, PSC's persist in the lowest stratospheric altitudes throughout September. Subsequently, October always represents a relative annual minimum in aerosol extinction above 15 km and in stratospheric column amount. In addition, volcanically produced aerosols in Antarctica peaked in early 1983 and, if linearly related to ozone losses, are probably not a contributing factor to the continued loss of total ozone in the Antarctic spring in 1984 and 1985.

Author

A87-23650

MULTILENS CAMERAS FOR HIGH VELOCITY/LOW ALTITUDE PHOTORECONNAISSANCE

GUENTHER DREYER (Carl Zeiss, Oberkochen, West Germany) Optical Engineering (ISSN 0091-3286), vol. 25, Nov. 1986, p. 1253-1260.

After an outline of the fundamentals of the multilens array combined with focal plane shutter and angle-correct forward motion compensation, the KS-153A Trilens and Pentalens arrays are described. Then the special ground resolution capability of the multilens camera is compared to that of the tricamera fan, and the geometric imaging capability is compared to that of the panoramic scan camera.

Author

A87-23786

AIRBORNE LASER PROFILING AND MAPPING SYSTEMS COME OF AGE


Red and near-infrared satellite data from the Advanced Very High Resolution Radiometer sensor have been processed over several days and combined to produce spatially continuous cloud-free imagery over large areas with sufficient temporal resolution to study green-vegetation dynamics. The technique minimizes cloud contamination, reduces directional reflectance and off-nadir viewing effects, minimizes sun-angle and shadow effects, and minimizes aerosol and water-vapor effects. The improvement is highly dependent on the state of the atmosphere, surface-cover type, and the viewing and illumination geometry of the sun, target and sensor. An example from southern Africa showed an increase of 40 percent from individual image values to the final composite image. Limitations associated with the technique are discussed, and recommendations are given to improve this approach.

Author
A87-26098
SATELLITE REMOTE SENSING OF METEOROLOGICAL PARAMETERS FOR GLOBAL NUMERICAL WEATHER PREDICTION
(Contract F19628-83-C-0027; F19628-84-C-0134; refs R. G. ISAACS, R. N. HOFFMAN, and L. D. KAPLAN PREDICTION PARAMETERS FOR GLOBAL NUMERICAL WEATHER and surface temperature and fluxes. The images and maps led to the identification of the storm as intrusion of weakly stratified polar air beneath a mid-tropospheric frontal zone.

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has been applied to mapping and differentiation of lava flows and to differentiation of forested and clear-cut areas. D.H.

A87-30885

WEATHER AND ATMOSPHERE REMOTE SENSING


Remotely sensed meteorological images, the first having been obtained by Tiros 1 in 1960, provide global maps of warmer systems, which may travel about 500 km/day. Numerical forecast can theoretically be accurate out to 14 days, i.e., the time span in which small eddies evolve into large-scale weather patterns. Lower atmosphere temperature and wind data are critical for weather predictions, with the accuracy of length of the prediction being dependent on the density of accurate data. The GARP experiment revealed the need for more accurate temperature data than currently available if prediction accuracy is to improve. A summary is presented of ongoing efforts to monitor the global sea surface temperature, atmospheric dust and volcanic aerosols, snow and ice cover extents and amounts, evapotranspiration, and the atmospheric content of anthropogenic CO2 in order to improve the chances of predicting long-term climatic changes. M.S.K.

A87-30895

THE INTERACTIVE EFFECT OF SPATIAL RESOLUTION AND DEGREE OF INTERNAL VARIABILITY WITHIN LAND-COVER TYPES ON CLASSIFICATION ACCURACIES


A study is made to assess the effect of spatial resolution on the degree of internal variability within land-cover classes and then to examine how this within-class variance affects classification accuracy. Airborne Multispectral Scanner data flown at 5 m resolution are degraded to simulate 10 and 20 m data. Classification accuracies within internally homogeneous classes are found to be high at all spatial resolutions. In contrast, classification accuracies of land-cover types characterized by a high degree of internal variability or scene noise improve by up to 20 per cent as spatial resolution is coarsened because the proportion of scene noise is reduced. A further improvement in classification can be achieved by smoothing the imagery prior to classification using various spatial filters. The extent of this improvement was found to be as much as 25 percent depending on the type of spatial filter used, the window size of the filter, the spatial resolution of the data and the land-cover type being classified.

Author

A87-31139

SPACE SHUTTLE CLOUD DETECTION AND EARTH FEATURE CLASSIFICATION EXPERIMENT


The Feature Identification and Location Experiment (FILE) that is being designed for the detection and classification of four primary earth features (water, vegetation, bare land, and the clouds-snow-ice class) is described. Consideration is given to the FILE classification technology concept and the FILE instrument, which will use two solid-state CCD cameras operating at 0.65 and 0.85-micron center frequency wavelengths, with the camera outputs being functions of the earth surface material radiance. The classification is based on camera output radiance ratio values. The preliminary analysis of the data collected on the STS 41-G mission is discussed. The results demonstrated the suitability of using the two-channel-ratio detection technology and a simple (y = mx) algorithm to autonomously classify the four earth surface features. The technology is especially attractive as a cloud sensor, where, in advance of or during a mission, a threshold value for cloud cover percentage can be programmed and/or adaptively modified for use in the control of other remote sensors. I.S.
N87-15628# Institut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).

FUTURE EUROPEAN PLANS IN THE FRAMEWORK OF THE INTERNATIONAL SATELLITE LAND SURFACE CLIMATOLOGY PROJECT (ISLSCP)
Avail: NTIS HC A99/MF A01

N87-15650# Texas Univ., Austin. Center for Space Research.
UNDERSEA VOLCANO PRODUCTION VERSUS LITHOSPHERIC STRENGTH FROM SATELLITE ALTIMETRY Semiannual Research Progress/Status Report, 1 Jun. - 31 Nov. 1986
B. D. TAPLEY and D. T. SANDWELL 20 Jan. 1986 8 p
Contract NAGS-787)
(NASA-CR-179984; NAS 12.6:179984) Avail: NTIS HC A02/MF A01 CSCL 08K

N87-15669# Pennsylvania State Univ., University Park. Dept. of Meteorology.
UTILIZATION OF SATELLITE DATA IN MESOSCALE MODELING OF SEVERE WEATHER Final Report
THOMAS T. WARNER 20 Jan. 1987 5 p
Contract NSG-5205)
(NASA-CR-179917; NAS 12.6:179917) Avail: NTIS HC A02/MF A01 CSCL 04B

The VISIBLE Infrared Spin Scan Radiometer Atmospheric Sounder (VAS) data were used to model the 36 hour cyclogenesis period over the Pacific Ocean. Various combinations of VAS data, conventional radiosonde data, and gridded data from the National Weather Service global analysis were used in successive-correction and variational objective-analysis procedures. The Penn State/NCAR mesoscale model was used to test the impact of the VAS data on a 12 hour forecast of convective precipitation in the midwestern U.S.

N87-16387# SRI International Corp., Menlo Park, Calif. Atmospheric Science Center.
DEVELOPMENT AND DEMONSTRATION OF ALARM (AIRBORNE LIDAR AGENT REMOTE MONITOR) Final Report
EDWARD E. UTHE, BRUCE M. MORLEY, and NORM B. NIELSEN Aug. 1986 125 p
(Contract DAAQ29-82-K-0175)
(AD-A172886; ARO-189542-GS) Avail: NTIS HC A06/MF A01 CSCL 17H

An airborne wavelength-tunable CO2 differential absorption lidar (DIAL) capable of making simultaneous measurements of atmospheric backscatter and surface-reflected energy has been developed and tested in a series of experiments. A data base of surface returns for a flight track that passed over ocean, farmland, urban, forest and grassland surfaces was collected for various lidar wavelengths and atmospheric separations. The data show that highest correlation between two-wavelength surface returns occurs over land surfaces and the highest decorrelation over ocean surfaces-the DIAL sensitivity for detection of chemical agents based on surface returns is significantly better over land than ocean areas. The data also show that the highest decorrelation is associated with the highest reflectivity surfaces of ocean and urban areas, probably a result of specular reflection. The correlation of surface returns decreases with increasing wavelength separation over land areas but is nearly independent of wavelength separation over ocean areas. The airborne DIAL system was demonstrated for mapping the cross-plume gas concentration distribution resulting from a near-surface release of SF6. A new Fourier analysis method was used to improve single pulse-pair signal-to-noise ratios.

N87-17110# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EVALUATION OF GEOPHYSICAL PARAMETERS MEASURED BY THE NIMBUS-7 MICROWAVE RADIOMETER FOR THE TOGA HEAT EXCHANGE PROJECT
W. TIMOTHY LIU and DONALD R. MOCK 1 Dec. 1986 26 p
Contract NAS7-918)
(NASA-CR-180151; JPL-PUB-86-50; NAS 12.6:180151) Avail: NTIS HC A03/MF A01 CSCL 08E

The data distributed by the National Space Science Data Center on the Geophysical parameters of precipitable water, sea surface temperature, and surface-level wind speed, measured by the Scanning Multichannel Microwave Radiometer (SMMR) on Nimbus-7, are evaluated in situ measurements between Jan. 1980 and Oct. 1983 over the tropical oceans. In tracking annual cycles and the 1982-83 El Nino/Southern Oscillation episode, the radiometer measurements are coherent with sea surface temperatures and surface-level wind speeds measured at equatorial buoys and with precipitable water derived from radiosonde soundings at tropical island stations. However, there are differences between SMMR and in situ measurements. Corrections based on radiosonde and ship data were derived supplementing correction formulae suggested in the databook. This study is the initial evaluation of the data for quantitative description of the 1982-83 El Nino/Southern Oscillation episode. It paves the way for determination of the ocean-atmosphere moisture and latent heat exchanges, a priority of the Tropical Ocean and Global Atmosphere (TOGA) Heat Exchange Program.

N87-17111# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE TIMS DATA USER'S WORKSHOP
ANNE B. KAHLE, ed. and ELSA ABBOTT, ed. 1 Nov. 1986 96 p
Workshop held in Bay Saint Louis, Miss., 18-19 Jun. 1985; sponsored by NASA NSTL Original contains color illustrations
(Contract NAS7-918)
(NASA-CR-180130; JPL-PUB-86-38; NAS 12.6:180130) Avail: NTIS HC A05/MF A01 CSCL 08E

A workshop was held to bring together all users of data from NASA's airborne Thermal Infrared Multispectral Scanner (TIMS). The purpose was to allow users to compare results, data processing algorithms, and problems encountered; to update the users on the latest instrument changes and idiosyncrasies, including distribution of the TIMS investigation guide; to inform the users of the wide range of problems that are currently being tackled by other TIMS investigators interested in expanding the user community; to discuss current areas where more basic research is required; and to discuss the future directions of NASA's thermal infrared remote sensing programs. Also discussed were: geology, land use, archeology; and data processing and noise research.
The scan head and spectrometer of the Thermal Infrared Multispectral Scanner (TIMS) are mounted in the unpressurized tail cone of a NASA/NSI/Learjet and operated through a hole cut through the skin. Design criteria are discussed. The digitized field of view is described. The functions of the scan head and spectrometer are examined.

B.G.

N87-17141* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SPACEBORNE IMAGING RADAR RESEARCH IN THE 90'S

CHARLES ELACHI In its The Second Spaceborne Imaging Radar Symposium p 45-55 1 Dec. 1986

Avail: NTIS HC A10/MF A01 CSCL 171

The imaging radar experiments on SEASAT and on the space shuttle (SIR-A and SIR-B) have led to a wide interest in the use of spaceborne imaging radars in Earth and planetary sciences. The radar sensors provide unique and complimentary information to what is acquired with visible and infrared imagers. This includes subsurface imaging in arid regions, all weather observation of ocean surface dynamic phenomena, structural mapping, soil moisture mapping, stereo imaging and resulting topographic mapping. However, experiments up to now have exploited only a very limited range of the generic capability of radar sensors. With planned sensor developments in the late 80's and early 90's, a quantum jump will be made in our ability to fully exploit the potential of these sensors. These developments include: multiparameter research sensors such as SIR-C and X-SAR, long-term and global monitoring sensors such as ERS-1, JERS-1, EOS, Radarsat, GLORI and the spaceborne sounder, planetary mapping sensors such as the Magellan and Cassini/Titan mappers, topographic three-dimensional imagers such as the scanning radar altimeter and three-dimensional rain mapping. These sensors and their associated research are briefly described.

Author

N87-17145* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PRESENT STATUTE OF JAPANESE ERS-1 PROJECT

YASUUMI ISHIWADA and YOSHIAKI NEMOTO In its The Second Spaceborne Imaging Radar Symposium p 79-83 1 Dec. 1986

Avail: NTIS HC A10/MF A01 CSCL 22B

Earth Resources Satellite 1 (ERS-1) will be launched in the FY 1990 with the H-1 rocket from Tanegashima Space Center. ERS-1 will seek to firmly establish remote sensing technologies from space by using synthetic aperture radar and optical sensors, as well as primarily exploring for non-renewable resources and also monitoring for land use, agriculture, forestry, fishery, conservation of environment, prevention of disasters, and surveillance of coastal regions. ERS-1 is a joint project in which the main responsibility for the development of the mission equipment is assumed by the Agency of Industrial Science and Technology, MITI, and the Technology Research Association of Resources Remote Sensing System, while that for the satellite itself and launching rocket is assumed by the Science and Technology Agency (STA) and the National Space Development Agency (NASA). In relation to this project, users have maintained a close working relationship with the manufacturers after submitting their requirements in 1984 on the specifications of the mission equipments. This missions parameters are outlined.

Author
MULTIPLE INCIDENCE ANGLE SIR-B EXPERIMENT OVER ARGENTINA

JOEBA CIMINO, DAREN CASEY, STEPHEN WALL, ALDO BRANDANI (Consejo Nacional de Investigaciones Científicas y Técnicas, Mar del Plata, Argentina), GITTA DOMIK (Vexcell Corp., Boulder, Colo.), and FRANZ LEBERL

In its The Second Spaceborne Imaging Radar Symposium p.165-173 1 Dec. 1986

Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set

$90 Member States, AU, CN, and NO (+20% others)

A digital stereo-scanner with three line sensor arrays working on the pushbroom principle and a suitable, rigorous compilation process was developed. It delivers the orientation data of the camera in selectable update points along the flight path of aircraft, spacecraft, or missiles, the three-dimensional coordinates of the digital elevation model, ortho and stereo-orthophotos, digital elements for line maps, and rectified multispectral images. By computer simulated operational models, the influence of the camera and flight parameters on the accuracy of the models were tested. Results show high stability and nearly constant accuracy over an entire strip model.

Author

THE STEREO-PUSHBROOM SCANNER SYSTEM DIGITAL PHOTOGRAMMETRY SYSTEM (DPS) AND ITS ACCURACY


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set

$90 Member States, AU, CN, and NO (+20% others)

A digital stereo-scanner with three line sensor arrays working on the pushbroom principle and a suitable, rigorous compilation process was developed. It delivers the orientation data of the camera in selectable update points along the flight path of aircraft, spacecraft, or missiles, the three-dimensional coordinates of the digital elevation model, ortho and stereo-orthophotos, digital elements for line maps, and rectified multispectral images. By computer simulated operational models, the influence of the camera and flight parameters on the accuracy of the models were tested. Results show high stability and nearly constant accuracy over an entire strip model.

Author

THE ROCKET LABORATORY INSTRUMENT FOR THE FUTURE ERS-1 MISSION: PERFORMANCE AND DATA VALIDATION


Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set

$90 Member States, AU, CN, and NO (+20% others)

Key characteristics of the ERS-1 radar altimeter and of the overall measurement system are described. Operating modes include ocean and ice. Calibration is based on ground test and
N87-17195# Mullard Space Science Lab., Dorking (England).  
AN AUTOMATIC TRACKING MODE SWITCHING ALGORITHM  
FOR THE ERS-1 ALTIMETER  
D. J. WINGHAM  
Aug. 1986  
(Contract ESTEC-6375/85-NL-B1)  
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08B  
A tracking system which switches automatically the ERS-1 radio altimeter tracking mode and the range window width is described. The system estimates the shape of the return, which may be used to control the instrument gain and determine if the return is sufficiently ocean-like for the use of an ocean specific error algorithm; and it provides a linear height error algorithm for a wide variety of return shapes, which permits the height error to be open or close the range window. The linear height error substantially improves the tracking performance in areas where the range to the surface is varying rapidly. Simulated performance over a variety of geographical surfaces, in particular the ocean, sea ice and ice shelves, and simulations of the altimeter and of the normal incidence radar returns from these surfaces are described. By combining these two, it is possible to assess the performance of the control system over these surfaces. The examples are deliberately chosen as worst case possibilities, and it is clear that the system offers a great increase in coverage over any previous system. 

N87-17202# Jet Propulsion Lab., California Inst. of Tech., Pasadena.  
IMAGING SPECTROMETRY: AIRCRAFT AND SPACE PROGRAM  
M. J. ABRAMS  
Aug. 1986  
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08B  
Imaging spectrometry for the remote sensing of the Earth is introduced. Reflected solar energy from the surface is dispersed in a spectrometer and used to form up to 200 registered spectral images. Each pixel has associated with it sufficient information for the reconstruction of a complete reflectance spectrum. The technique allows the diagnostic narrow band spectral features that are characteristic of many surface materials to be used to identify those materials. These spectral features are typically 20 to 40 nm wide; spectral imaging systems which acquire data in contiguous 10 nm bands therefore have sufficient resolution for direct identification of those materials with diagnostic spectral bands. 

N87-17204# Jet Propulsion Lab., California Inst. of Tech., Pasadena.  
ANALYSIS OF AIS RADIOMETRY AT MONO LAKE, CALIFORNIA  
J. E. CONEL, S. L. ADAMS, R. E. ALLEY, G. L. HOOVER, and S. SCHULTZ  
Aug. 1986  
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 08B  
Airborne imaging spectrometer (AIS) data were studied to establish absolute instrumental calibration and to provide atmospheric corrections. Good agreement is found between calculated and measured radiances for uniform surface targets (beaches), but simulations of atmospheric properties with LOWTRAN lead to unreasonably low values of atmospheric precipitable water. Absorptions from CO2 are not detected in the AIS data, but are strongly present in the LOWTRAN model. The apparent low contrast of all atmospheric absorption bands leads to a study of contamination from overlapping spectral orders in the AIS data. The suspected contamination is shown unambiguously to be present beyond 1500 nm. The magnitude remains uncertain. Spectral band filling at 1400 nm cannot be accounted for by order mixing because of the 800 nm blocking filter used. Rough corrections for short wavelength mode observations might be possible if an after-the-fact radiometric calibration of the instrument can be developed. 

THE SEQUENTIAL FILTER IMAGING RADIOMETER (SFIR), A NEW INSTRUMENT CONFIGURATION FOR EARTH OBSERVATIONS  
M. S. MAXWELL  
Aug. 1986  
(Contract NAS5-28057)  
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 14B  
The sequential filter imaging radiometer (SFIR) concept is presented, contrasted with other sensor configurations, and its strengths and weaknesses discussed. In a pushbroom SFIR the optics images the scene onto a long, narrow area array. The length of the array defines the field of view. The spectral defining filters are sequentially placed over the full array, a sample of data for that band taken, and then the next filter placed in front of the array. All of the filters are placed over the array in the time that it takes the image of the scene to advance the array width. Thus the entire scene is observed in each band. Advantages of the SFIR are: spectral bands can be broad, narrow or overlap; it is easy to improve signal to noise ratio; and it is simple to make bands polarized. Its main disadvantage is that it requires more detectors than other instrument configurations. 

N87-17224# European Space Agency, European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).  
ERS-1 FAST DELIVERY PROCESSING AND PRODUCTS  
J. P. GUIGNARD  
Aug. 1986  
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others) CSCL 14B  
The ERS-1 satellite SAR image mode and wave mode products, scatterometer products, and altimeter products are listed. Ground station organization and facilities are described. 

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In the context of remote sensing, the serious limitations of conventional mechanical and optical systems are discussed. The concept of a thinned array radiometer is described as an alternate to large filled apertures to achieve high resolution imaging from space. The serious limitations of conventional mechanical scanning systems and the practical problems associated with a multiple receiver pushbroom system that utilizes a large antenna are discussed. The thinned array is developed in terms of aperture synthesis techniques used in radio astronomy. Examples of thinned array configurations are presented, and future directions are discussed.

Application of spaceborne distributed aperture/coherent array processing (SDA/CAP) technology to active and passive microwave remote sensing is discussed. This technology differs from conventional monostatic remote sensing approaches in that sensor elements are distributed among many space platforms. It is possible to coherently combine the inputs from many receiving spacecraft in order to form a very large distributed aperture, thousands of kilometers in size. This enormous effective aperture size can provide nanoradian resolution in the microwave region of the spectrum. Relative spacecraft phase measurement accuracies on the order of a fraction of a wavelength are required to support the technology. Spacecraft relative position and time measurement via hydrogen maser time references on each spacecraft and laser ranging between spacecraft is proposed. Intersatellite laser ranging technology needs to be developed to support the application of SDA/CAP techniques for advanced space environmental remote sensor systems.

Modest-resolution radars without radiometers are so much simpler than focussed SARs that they can provide useful alternatives when image resolution need not be fine, such as geologic exploration, soil-moisture measurement, and mapping ocean features other than wave spectra. Modest-resolution radar systems often require transmitter power of only milliwatts; under some conditions the power required is less than that of the local oscillator of the accompanying radiometer receiver. The lowest power requirement is for forward-looking radars that achieve modest resolution in the along-track direction by Doppler filtering.
N87-17324# INTERA Environmental Consultants Ltd., Ottawa (Ontario).
THERMAL INFRARED REMOTE SENSING: ONE OF TODAY'S SOLUTIONS
Avail: NTIS HC A17/MA F01; ESA, Paris, France, 3 volume set
$90 Member States, AU, CN, and NO (+20% others)
Airborne thermal infrared linescanning programs for environmental and engineering applications are summarized. Individual airborne thermal surveys are discussed with pertinent logistics described for each. Thermal infrared imagery for specific applications is included. It is shown how operational thermal imaging linescanning programs are utilized to satisfy the requirements of resource and utility managers. ESA

N87-17325# Tokyo Univ. (Japan).
MODELS FOR TEMPERATURE ESTIMATION FROM REMOTELY SENSED THERMAL IR DATA
Avail: NTIS HC A17/MA F01; ESA, Paris, France, 3 volume set
$90 Member States, AU, CN, and NO (+20% others)
The accuracy of the temperatures estimated from remotely sensed thermal IR data was evaluated by comparison with ground measurements. A relation between them is derived from a simple physical model, on which the evaluation should be based. The atmosphere is represented by a thin layer with a transmittance and an effective temperature. Four kinds of models slightly modified from one to another are considered. The regression coefficients obtained through regression analysis by taking the estimated temperature as dependent variable, and the measured one as independent variable are discussed. It is shown for all the models that the regression coefficient should be less than 1. Most of actual data taken over the sea satisfy this relation. ESA

N87-17329# Kanazawa Univ. (Japan).
RADIOMETRIC CORRECTION METHOD WHICH REMOVES BOTH ATMOSPHERIC AND TOPOGRAPHIC EFFECTS FROM THE LANDSAT-MSS DATA
Avail: NTIS HC A17/MA F01; ESA, Paris, France, 3 volume set
$90 Member States, AU, CN, and NO (+20% others)
A radiometric correction method which can remove atmospheric and topographic effects from rugged terrain image data remotely sensed by LANDSAT was applied to a mountainous test site where digital terrain data is available. The values of necessary atmospheric parameters, such as the optical thickness, the single scattering albedo, and the turbidity factor of the atmosphere were derived from LOWTRAN 5 Code in the evaluation of scattering and transmission functions. Lambert's law of reflection on the ground surface is assumed. Results are satisfactory. ESA

N87-17353# Kombinet VEB Carl Zeiss, Jena (East Germany).
OPTICAL VISUAL EVALUATION AND INTERPRETATION OF REMOTE SENSING DATA
Avail: NTIS HC A17/MA F01; ESA, Paris, France, 3 volume set
$90 Member States, AU, CN, and NO (+20% others)
A photographic system for satellite-borne remote sensing is described. The multispectral camera operates with 6 parallely aligned normal-angle lenses of 125 mm focal length and 6 separate cassettes for 70 mm film. The film frames have the format 81 mm x 56 mm with the longer side being transverse to the flight direction. A narrow-band interference filter is attached to each lens (centroid wavelengths 480, 540, 600, 660, 720, 840 nm). At 250 km altitude, the camera supplies photographs at the scale 1:2,000,000 covering an area of 160 km x 110 km and allowing a detail recognizability of 10 to 25 m. Ground processing is achieved by instruments for multispectral projection, stereoscopic viewing and superposition, and optical-mechanical rectification. ESA

N87-17358# National Space Development Agency, Ibaraki (Japan).
A SATELLITE-BORNE SAR TRANSMITTER AND RECEIVER
Avail: NTIS HC A17/MA F01; ESA, Paris, France, 3 volume set
$90 Member States, AU, CN, and NO (+20% others)
A SAR transmitter-receiver for Earth observations from space was designed for the Japanese Earth Resources Satellite-1. Thermal vacuum and vibration tests were executed on critical components, i.e., the oscillator, the high power amplifier, the power supply for the high power amplifier, and the chirp pulse generator. Results prove that the thermal and structural design is satisfactory. Subsystem designs were verified by evaluating the SAR R and D model. ESA

N87-17360# National Space Development Agency, Ibaraki (Japan). Tsukuba Space Center.
PULSE COMPRESSION TEST RESULTS OF THE SAR TRANSMITTER AND RECEIVER
Avail: NTIS HC A17/MA F01; ESA, Paris, France, 3 volume set
$90 Member States, AU, CN, and NO (+20% others)
The pulse compression test principle and the test results on the breadboard model of the spaceborne SAR for the Japanese Earth Resources Satellite 1 are summarized. Using their own transmitter chirp pulse as the test signal for the transmitter-receiver, the resultant receiver output pulses are digitized and recorded by high density digital tape recorder then processed by the ideal matched-filter. The usefulness of the pulse compression test method for evaluation of the SAR transmitter-receiver in view of range focusing capability is emphasized. A pulse compression ratio greater than 392 is obtained. ESA

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**PROCEEDINGS OF AN ESA WORKSHOP ON ERS-1 WIND AND WAVE CALIBRATION**


Workshop held in Schliersee, West Germany, 2-6 Jun. 1986; sponsored by ESA

(ESA-SP-262; ISSN-0072-6566; ETN-87-98836) Avail: NTIS HC A11/MF A01

Classification of ERS-1 wind and wave measurements; wind and wave models; surface and airborne measurements to calibrate the ERS-1 instruments; and planned and on-going climate and oceanographic programs were discussed.

**ERS-1 MISSION CONSTRAINTS RELATED TO WIND AND WAVE CALIBRATION**


The approach taken for validation and calibration of the ERS-1 mission is outlined. A clear distinction is made between the engineering and geophysical performances of the mission. The pre and post-launch activities required to calibrate the ERS-1 system and validate the geophysical performance are described.

**RESULTS RELEVANT TO ERS-1 WIND AND WAVE CALIBRATION**


Results from Convar 580 wind and wave measurement campaigns are presented to demonstrate the usefulness of such an airborne microwave research facility for ERS-1 dedicated calibration and validation experiments. Scatterometer measurements from the PROMESS campaigns show that C-band sensitivity for wind speeds (2 to 12 m/sec) is 70% to 80% of the Ku-band sensitivity. It is also shown that the ERS-1 active microwave image mode should be able to detect surface oil as a 5 to 7 dB drop in scattering cross section when observed at 23 deg incidence angle. Ship targets, however, may be lost in the sea clutter for wind speeds greater than 8 m/sec. Results from the Cape Sable SAR wave imagery experiments indicate that airborne SAR can be used to investigate the effect of R/V scaling and look direction on azimuthal falloff in SAR derived directional wave spectra.

**THE USE OF AIRCRAFT FOR WIND SCATTEROMETER CALIBRATION**


The use of a Hercules aircraft to assist in the calibration and verification of ERS wind scatterometer products is proposed. The capabilities of this aircraft and its advantages are described, and compared to other sources of calibration data.

DEVELOPMENT IN RADAR ALTIMETRY: THE NAVY GEOSAT MISSION


(Contract N00024-86-PR-69506)

Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The Geosat radar altimeter and its data set are described. The Geosat radar altimeter is identical to the SEASAT-A altimeter in terms of the mechanical, thermal, and electrical interfaces. Changes were made primarily to support an 18-month mission goal. These include use of a 20-W long-life TWT amplifier and, for improved radiation tolerance, an 8085 microprocessor. Other changes include substitutions for parts no longer available and revised firmware tracking algorithms for reduced height noise. It measures altitude: 3.5 cm for 2-m significant wave height; significant wave height: 10% of significant wave height or 0.5 m; and wind speed: 1.8 m/sec over the range 1 to 18 m/sec.

N87-18164# Mullard Space Science Lab., Dorking (England).

NEW TECHNIQUES IN SATELLITE ALTIMETER TRACKING SYSTEMS


(Contract ESTEC-6079/84-NL-PB(SC))

Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

A satellite radar altimeter tracking algorithm was designed to permit robust tracking of topographic surfaces without compromising the accuracy or precision of the altimeter over the ocean. The altimeter was applied to the SEASAT system. It generates a pulse shape independent linear height error and a pulse shape dependent gain error. The algorithm has acceptable performance in the presence of fading and thermal noise.

N87-18178# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).

INTELLIGENT SAR PROCESSOR (ISAR), A NEW CONCEPT FOR HIGH THROUGHPUT AND HIGH PRECISION DIGITAL SAR PROCESSING


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The ISAR knowledge-based digital SAR processor for ERS-1 is presented. All central parts of the software system are managed by the expert system running on the Knowledge Engineering Workstation (KEW). The KEW controls the whole production process by receiving production orders from the processing and archiving facility; configuring the production process; supervising the correlation sequence; and supporting the operator in all decision processes. The specified processing time of 30 min for a standard bulk product is possible using an ST-100 array processor, and considerable speed up is possible.

N87-18197# Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Radio and Space Science.

 ATMOSPHERIC WATER VAPOR CORRECTIONS FOR ALTIMETRY MEASUREMENTS


Sponsored by ESA and the Swedish Board for Space-Activities

Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Two methods to estimate path delay based on atmospheric modeling were developed. One uses a closed form model of the atmosphere where two parameters describe typical variations of temperature and humidity with height. The other employs discretized atmospheric profiles derived from radiosonde statistics and surface data. Methods for delay estimation by water vapor radiometry were also developed. The methods are compared with radiosonde data. Root mean square errors range from 3.9 cm for the closed form model to 0.77 cm for the best water vapor radiometry algorithm. The use of water vapor estimates from meteorological satellites and possibilities to improve these are discussed.

N87-18219# Indian Space Research Organization, Ahmedabad. Space Applications Centre.

RETRIEVAL AND GLOBAL COMPARISON OF OCEANIC WINDS FROM SEASAT RADIODER, SCATTEROMETER AND ALTIMETER


Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Wind speed was retrieved using different channel combinations of SEASAT Scanning Multichannel Microwave Radiometer data. Comparison with high quality in situ observations obtained during Joint Air-Sea Interaction Experiment gives an rms difference of better than + or - 2 m/sec. Global maps of oceanic winds were generated and compared with maps obtained from scatterometer and altimeter derived winds. The three sensors depict general features of wind distribution but differ quantitatively over certain latitude belts.
The first objective was to evaluate the postlaunch radiometric calibration of the LANDSAT Thematic Mapper (TM) band 6 data. The second objective was to determine to what extent surface temperatures could be computed from the TM and 6 data using atmospheric propagation models. To accomplish this, ground truth data were compared to a single TM-4 band 6 data set. This comparison indicated satisfactory agreement over a narrow temperature range. The atmospheric propagation model (modified LOWTRAN 5A) was used to predict surface temperature values based on the radiance at the spacecraft. The aircraft data were calibrated using a multi-altitude profile calibration technique which had been extensively tested in previous studies. This aircraft calibration permitted measurement of surface temperatures based on the radiance reaching the aircraft. When these temperature values are evaluated, an error in the satellite’s ability to predict surface temperatures can be estimated. This study indicated that by carefully accounting for various sensor calibration and atmospheric propagation effects, and expected error (1 standard deviation) in surface temperature would be 0.9 K. This assumes no error in surface emissivity and no sampling error due to target location. These results indicate that the satellite calibration is within nominal limits to within this study’s ability to measure error.

The Shuttle Imaging Radar-C (SIR-C) mission will yield new and advanced scientific studies of the Earth. SIR-C will be the first instrument to simultaneously acquire images at L-band and C-band with HH, VV, HV, or VH polarizations, as well as images of the phase difference between HH and VV polarizations. These data will be digitally encoded and recorded on board high-density digital tape recorders and will later be digitally processed into images using the JPL Advanced Digital SAR Processor. SIR-C geologic studies include cold-region geomorphology, fluvial geomorphology, rock weathering and erosional processes, tectonics and geologic boundaries, geobotany, and radar stereogrammetry. Hydrology investigations cover arid, humid, wetland, snow-covered, and high-latitude regions. Additionally, SIR-C will provide the data to identify and map vegetation types, interpret landscape patterns and processes, assess the biophysical properties of plant canopies, and determine the degree of radar penetration of plant canopies. In oceanography, SIR-C will provide the information necessary to: forecast ocean directional wave spectra; better understand internal wave-current interactions; study the relationship of ocean-bottom features to surface expressions and the correlation of wind signatures to radar backscatter; and detect current-system boundaries, oceanic fronts, and mesoscale eddies. And, as the first spaceborne SAR with multi-frequency, multi-polarization imaging capabilities, whole new areas of glaciology will be opened for study when SIR-C is flown in a polar orbit.

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A87-29433
BUSINESS APPROACH TO EARTH OBSERVATION APPLICATIONS

The business side of commercial remote sensing operations is examined. Satellite sensors can collect data on resources, e.g., mineralogical or agricultural, and atmospheric and oceanic processes, e.g., climate and currents. It is easier to assign a value to measurements of tangible resources than to intangible factors such as the environment, although all resource monitoring is useful, and in many cases necessary, due to rapid population growth, on the global, regional and local scales. Graphic techniques are defined for assessing the economic feasibility of establishing and operating a remote sensing system, manufacturing sensors, or operating in the presence or competition. No fully commercial remote sensing operation now exists; both EOSAT and SPOT rely heavily on various forms of subsidies from the U.S. and French governments, respectively.

M.S.K.

A87-30876
SPACE SCIENCE AND APPLICATIONS: PROGRESS AND POTENTIAL

The evolution, growth, goals and applications of space technologies and capabilities are explored in depth. Experimentation using manned and unmanned spacecraft, Skylab, and the Shuttle to explore sun-earth relations, phenomena and planetary bodies in the solar system, observe and measure astrophysical phenomena, and perform life sciences studies are described. The applications, data collected, and future systems for remote sensing of the earth are summarized. Past, present, and future studies of and industrial scale performance of processing materials in space are examined, with emphasis on NASA efforts to foster commercial development in this area. Finally, the evolution and capabilities of the technologies, designs, and applications of satellites communications systems for data transfer, navigation, telephony, television broadcasts, etc., is traced. The impacts the Space Station and related systems will have on current and future operational space systems are also explored.

M.S.K.

A87-30881
REMOTE SENSING FROM SPACE - AN OVERVIEW

Current and future capabilities and applications of space-based remote sensing of the earth are described. A brief history of remote sensing is also presented, starting from Aristotle's camera obscura 2300 yr in the past. Research to date on space-based imaging has concentrated on sensor development and preprocessing techniques. Future research will target information extraction, understanding and modeling. The capabilities of the LANDSAT series of spacecraft and the SPOT are reviewed, noting a move toward merging the sensors with digital processing technology, and toward partially automated image processing capabilities which will ameliorate present labor-intensive analysis and processing procedures. One option that is described is to include on-board selection of packaged algorithms for image processing. The human role will become that of applying sophisticated phenomenon models to information from massive databases.

M.S.K.

N87-16662#
AERONAUTICS AND SPACE REPORT OF THE PRESIDENT: 1985 ACTIVITIES
1986 132 p
Avail: NTIS HC A07/MA A01

The achievements of aeronautics and space programs in the United States for 1985 are summarized in the areas of communications; Earth atmosphere, environment, and resources; space science; space transportation; commercial use of space; space tracking and data systems; space station; and aeronautics and space research and technology. The achievements of each of the following organizations are described: National Aeronautics and Space Administration, Department of Defense, Department of Commerce, Department of Energy, Department of the Interior, Department of Agriculture, Federal Communications Commission, Department of Transportation, Environmental Protection Agency, National Science Foundation, Smithsonian Institution, Department of State, Arms Control and Disarmament Agency, and United States Information Agency. Appendices provide historical information on launches, satellites, manned and unmanned spacecraft, and federal budgets for aeronautical and astronomical activities.

J.P.B.
The use of space technology in federally funded Earth science research in the United States was reviewed. Government departments and independent agencies, representing the primary Earth science research agencies in the Federal government, participated in the review: NASA, NOAA, Department of the Interior, Department of Agriculture, Department of Energy, U.S. Army Corps of Engineers, Agency for International Development, National Science Foundation, and Environmental Protection Agency. The review indicates that, while there is considerable overlap in the legislated missions of the Earth science agencies, most of the space-related land processes research is complementary.

Operational ground support of remote sensing from satellites or aircraft is described. The laboratory facilities are detailed. The activities include flight coordination, film and quick look processing, densitometry, scanner data conversion to computer compatible tape, image processing and analysis, and developing of new applications.

The needs of the remote sensing research and application community which will be served by the Earth Observing System (EOS) and space station, including associated polar and co-orbiting platforms are examined. Research conducted was used to extend and expand existing remote sensing research activities in the areas of georeferenced information systems, machine assisted information extraction from image data, artificial intelligence, and vegetation analysis and modeling. Projects are discussed in detail.
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