PREVIOUS EARTH RESOURCE BIBLIOGRAPHIES

Remote Sensing of Earth Resources (NASA SP-7036)
Earth Resources (NASA SP-7041(01))
Earth Resources (NASA SP-7041(02))
Earth Resources (NASA SP-7041(03))
Earth Resources (NASA SP-7041(04))
Earth Resources (NASA SP-7041(05))
Earth Resources (NASA SP-7041(06))
Earth Resources (NASA SP-7041(07))
Earth Resources (NASA SP-7041(08))
Earth Resources (NASA SP-7041(09))
Earth Resources (NASA SP-7041(10))
Earth Resources (NASA SP-7041(11))
Earth Resources (NASA SP-7041(12))
Earth Resources (NASA SP-7041(13))
Earth Resources (NASA SP-7041(14))
Earth Resources (NASA SP-7041(15))
Earth Resources (NASA SP-7041(16))
Earth Resources (NASA SP-7041(17))
Earth Resources (NASA SP-7041(18))
Earth Resources (NASA SP-7041(19))

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

A Continuing Bibliography
With Indexes
Issue 20

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between October 1, 1978 and December 31, 1978

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

NASA
Scientific and Technical Information Branch
National Aeronautics and Space Administration
Washington, DC
1979
This Supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, at the price code E05 ($9.00 domestic; $18.00 foreign).
INTRODUCTION

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

This literature survey lists 273 reports, articles, and other documents announced between October 1 and December 31, 1978 in Scientific and Technical Aerospace Reports (STAR), and International Aerospace Abstracts (IAA).

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

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

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

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

IAA entries identified by accession number series A78-10,000 in ascending accession number order;

STAR entries identified by accession number series N78-10,000 in ascending accession number order.

After the abstract section, there are five indexes:

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

IAA ENTRIES (A78-10000 Series)

All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc. (AIAA), as follows: Paper copies of accessions are available at $6.00 per document up to a maximum of 20 pages. The charge for each additional page is $0.25. Microfiche (1) of documents announced in IAA are available at the rate of $2.50 per microfiche on demand, and at the rate of $1.10 per microfiche for standing orders for all IAA microfiche. The price for the IAA microfiche by category is available at the rate of $1.25 per microfiche plus a $1.00 service charge per category per issue. Microfiche of all the current AIAA Meeting Papers are available on a standing order basis at the rate of $1.35 per microfiche.

Minimum air-mail postage to foreign countries is $1.00 and all foreign orders are shipped on payment of pro-forma invoices.

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

STAR ENTRIES (N78-10000 Series)

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

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

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

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

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

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, at the standard $3.00 price, for those documents identified by a # symbol.)

(1) A microfiche is a transparent sheet of film, 105 by 148 mm in size, containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 26:1 reduction).
Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Documents Room (Room 126), 600 Independence Ave., S.W., Washington, D.C. 20546, or public document rooms located at each of the NASA research centers, the NASA Space Technology Laboratories, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

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

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

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

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

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

Avail: ZLDI. Sold by the Zentralstelle für Luftfahrdokumentation und -Information, Munich, Federal Republic of Germany, at the price shown in deutschmarks (DM).

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


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

**Subscription Availability**

This publication is available on subscription from the National Technical Information Service (NTIS). The annual subscription rate for the quarterly supplements is $30.00 domestic; $60.00 foreign. All questions relating to the subscription should be referred to NTIS, Attn: Subscriptions, 5285 Port Royal Road, Springfield, Virginia 22161.
# ADDRESSES OF ORGANIZATIONS

<table>
<thead>
<tr>
<th>Organization</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Institute of Aeronautics and Astronautics</td>
<td>Technical Information Service</td>
</tr>
<tr>
<td>750 Third Ave.</td>
<td>New York, N.Y. 10017</td>
</tr>
<tr>
<td>British Library Lending Division.</td>
<td>Boston Spa, Wetherby, Yorkshire, England</td>
</tr>
<tr>
<td>Commissioner of Patents and Trademarks</td>
<td>U.S. Patent and Trademark Office</td>
</tr>
<tr>
<td>Washington, D.C. 20231</td>
<td>Department of Energy</td>
</tr>
<tr>
<td>Technical Information Center</td>
<td>P.O. Box 62</td>
</tr>
<tr>
<td>Oak Ridge, Tennessee 37830</td>
<td></td>
</tr>
<tr>
<td>ESA-Information Retrieval Service</td>
<td>ESRIN</td>
</tr>
<tr>
<td>Via Galileo Galilei</td>
<td>00044 Frascati (Rome) Italy</td>
</tr>
<tr>
<td>Her Majesty's Stationery Office</td>
<td>P.O. Box 569, S.E. 1</td>
</tr>
<tr>
<td>London, England</td>
<td></td>
</tr>
<tr>
<td>NASA Scientific and Technical Information Facility</td>
<td>U.S. Patent and Trademark Office</td>
</tr>
<tr>
<td>P.O. Box 8757</td>
<td>Washington, D.C. 20242</td>
</tr>
<tr>
<td>B. W. I. Airport, Maryland 21240</td>
<td>U.S. Geological Survey</td>
</tr>
<tr>
<td>National Aeronautics and Space Administration</td>
<td>1033 General Services Administration Building</td>
</tr>
<tr>
<td>Scientific and Technical Information Branch (NST-41)</td>
<td>Washington, D.C. 20242</td>
</tr>
<tr>
<td>National Technical Information Service</td>
<td>601 E. Cedar Avenue</td>
</tr>
<tr>
<td>5285 Port Royal Road</td>
<td>Flagstaff, Arizona 86002</td>
</tr>
<tr>
<td>Springfield, Virginia 22161</td>
<td></td>
</tr>
<tr>
<td>U.S. Geological Survey</td>
<td>Bidg. 25, Denver Federal Center</td>
</tr>
<tr>
<td>345 Middlefield Road</td>
<td>Denver, Colorado 80225</td>
</tr>
<tr>
<td>National Technical Information Service</td>
<td>Zentralstelle fuer Luft Raumfahrt</td>
</tr>
<tr>
<td>5285 Port Royal Road</td>
<td>Dokumentation U. Information</td>
</tr>
<tr>
<td>Springfield, Virginia 22161</td>
<td>c/o Fachinformationszentrum E P M</td>
</tr>
<tr>
<td>U.S. Geological Survey</td>
<td>Attn: Library</td>
</tr>
<tr>
<td>345 Middlefield Road</td>
<td>Kernforschungszentrum</td>
</tr>
<tr>
<td>Menlo Park, California 94025</td>
<td>7514 Eggenstein Leopoldsaffenz</td>
</tr>
<tr>
<td>U.S. Geological Survey</td>
<td>Federal Republic of Germany</td>
</tr>
</tbody>
</table>
## NTIS PRICE SCHEDULES

### Schedule A

**STANDARD PAPER COPY PRICE SCHEDULE**

*(Effective October 1, 1977)*

<table>
<thead>
<tr>
<th>Price Code</th>
<th>Page Range</th>
<th>North American Price</th>
<th>Foreign Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>Microfiche</td>
<td>$ 3.00</td>
<td>$ 4.50</td>
</tr>
<tr>
<td>A02</td>
<td>001-025</td>
<td>4.00</td>
<td>8.00</td>
</tr>
<tr>
<td>A03</td>
<td>026-050</td>
<td>4.50</td>
<td>9.00</td>
</tr>
<tr>
<td>A04</td>
<td>051-075</td>
<td>5.25</td>
<td>10.50</td>
</tr>
<tr>
<td>A05</td>
<td>076-100</td>
<td>6.00</td>
<td>12.00</td>
</tr>
<tr>
<td>A06</td>
<td>101-125</td>
<td>6.50</td>
<td>13.00</td>
</tr>
<tr>
<td>A07</td>
<td>126-150</td>
<td>7.25</td>
<td>14.50</td>
</tr>
<tr>
<td>A08</td>
<td>151-175</td>
<td>8.00</td>
<td>16.00</td>
</tr>
<tr>
<td>A09</td>
<td>176-200</td>
<td>9.00</td>
<td>18.00</td>
</tr>
<tr>
<td>A10</td>
<td>201-225</td>
<td>9.25</td>
<td>18.50</td>
</tr>
<tr>
<td>A11</td>
<td>226-250</td>
<td>9.50</td>
<td>19.00</td>
</tr>
<tr>
<td>A12</td>
<td>251-275</td>
<td>10.75</td>
<td>21.50</td>
</tr>
<tr>
<td>A13</td>
<td>276-300</td>
<td>11.00</td>
<td>22.00</td>
</tr>
<tr>
<td>A14</td>
<td>301-325</td>
<td>11.75</td>
<td>23.50</td>
</tr>
<tr>
<td>A15</td>
<td>326-350</td>
<td>12.00</td>
<td>24.00</td>
</tr>
<tr>
<td>A16</td>
<td>351-375</td>
<td>12.50</td>
<td>25.00</td>
</tr>
<tr>
<td>A17</td>
<td>376-400</td>
<td>13.00</td>
<td>26.00</td>
</tr>
<tr>
<td>A18</td>
<td>401-425</td>
<td>13.25</td>
<td>26.50</td>
</tr>
<tr>
<td>A19</td>
<td>426-450</td>
<td>14.00</td>
<td>28.00</td>
</tr>
<tr>
<td>A20</td>
<td>451-475</td>
<td>14.50</td>
<td>29.00</td>
</tr>
<tr>
<td>A21</td>
<td>476-500</td>
<td>15.00</td>
<td>30.00</td>
</tr>
<tr>
<td>A22</td>
<td>501-525</td>
<td>15.25</td>
<td>30.50</td>
</tr>
<tr>
<td>A23</td>
<td>526-550</td>
<td>15.50</td>
<td>31.00</td>
</tr>
<tr>
<td>A24</td>
<td>551-575</td>
<td>16.25</td>
<td>32.50</td>
</tr>
<tr>
<td>A25</td>
<td>576-600</td>
<td>16.50</td>
<td>33.00</td>
</tr>
</tbody>
</table>

1/ Add $2.50 for each additional 100 page increment from 601 pages up.
2/ Add $5.00 for each additional 100 page increment from 601 pages up.

### Schedule E

**EXCEPTION PRICE SCHEDULE**

*Paper Copy & Microfiche*

<table>
<thead>
<tr>
<th>Price Code</th>
<th>North American Price</th>
<th>Foreign Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>E01</td>
<td>$ 3.25</td>
<td>$ 6.50</td>
</tr>
<tr>
<td>E02</td>
<td>4.75</td>
<td>9.50</td>
</tr>
<tr>
<td>E03</td>
<td>6.25</td>
<td>12.50</td>
</tr>
<tr>
<td>E04</td>
<td>7.50</td>
<td>15.00</td>
</tr>
<tr>
<td>E05</td>
<td>9.00</td>
<td>18.00</td>
</tr>
<tr>
<td>E06</td>
<td>10.50</td>
<td>21.00</td>
</tr>
<tr>
<td>E07</td>
<td>12.50</td>
<td>25.00</td>
</tr>
<tr>
<td>E08</td>
<td>15.00</td>
<td>30.00</td>
</tr>
<tr>
<td>E09</td>
<td>17.50</td>
<td>35.00</td>
</tr>
<tr>
<td>E10</td>
<td>20.00</td>
<td>40.00</td>
</tr>
<tr>
<td>E11</td>
<td>22.50</td>
<td>45.00</td>
</tr>
<tr>
<td>E12</td>
<td>25.00</td>
<td>50.00</td>
</tr>
<tr>
<td>E13</td>
<td>28.00</td>
<td>56.00</td>
</tr>
<tr>
<td>E14</td>
<td>31.00</td>
<td>62.00</td>
</tr>
<tr>
<td>E15</td>
<td>34.00</td>
<td>68.00</td>
</tr>
<tr>
<td>E16</td>
<td>37.00</td>
<td>74.00</td>
</tr>
<tr>
<td>E17</td>
<td>40.00</td>
<td>80.00</td>
</tr>
<tr>
<td>E18</td>
<td>45.00</td>
<td>80.00</td>
</tr>
<tr>
<td>E19</td>
<td>50.00</td>
<td>100.00</td>
</tr>
<tr>
<td>E20</td>
<td>60.00</td>
<td>120.00</td>
</tr>
</tbody>
</table>

*Write for quote*

No1 28.00 40.00
Subject Categories

Abstracts in this Bibliography are grouped under the following categories:

01 AGRICULTURE AND FORESTRY
   Includes crop forecasts, crop signature analysis, soil identification, disease
detection, harvest estimates, range resources, timber inventory, forest fire
detection, and wildlife migration patterns. 229

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. 235

03 GEODESY AND CARTOGRAPHY
   Includes mapping and topography. 237

04 GEOLOGY AND MINERAL RESOURCES
   Includes mineral deposits, petroleum deposits, spectral properties of rocks,
geological exploration, and lithology. 239

05 OCEANOGRAPHY AND MARINE RESOURCES
   Includes sea-surface temperature, ocean bottom surveying imagery, drift
rates, sea ice and icebergs, sea state, fish location. 245

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. 253

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS
   Includes film processing, computer technology, satellite and aircraft hard-
ware, and imagery. 257

08 INSTRUMENTATION AND SENSORS
   Includes data acquisition and camera systems and remote sensors. 263

09 GENERAL
   Includes economic analysis. 267

SUBJECT INDEX ................................................................. A-1
PERSONAL AUTHOR INDEX ................................................ B-1
CORPORATE SOURCE INDEX .......................................... C-1
CONTRACT NUMBER INDEX ........................................ D-1
REPORT/ACCESSION NUMBER INDEX .............................. E-1
### Typical Citation and Abstract from STAR

**Title:** A Modular Radiative Transfer Program for Gas Filter Correlation Radiometry  
**Authors:** Joseph C. Casas and Shirley A. Campbell  
**Affiliation:** Old Dominion Univ. Research Foundation, Norfolk, Va.  
**Contract or Grant Number:** (Grant NsG-1127)  
**Publication Date:** Oct. 1977  
**Report Number:** NASA-CR-2895; PGSTR-AP77-49  
**Availability:** NTIS HC A04/MF A01 CSCL 04A  

The fundamentals of a computer program, simulated monochromatic atmospheric radiative transfer (SMART), which calculates atmospheric path transmission, solar radiation, and thermal radiation in the 4.6 micrometer spectral region, are described. A brief outline of atmospheric absorption properties and line by line transmission calculations is explained in conjunction with an outline of the SMART computational procedures. Program flexibility is demonstrated by simulating the response of a gas filter correlation radiometer as one example of an atmospheric infrared sensor. Program limitations, input data requirements, program listing, and comparison of SMART transmission calculations are presented.

### Typical Citation and Abstract from IAA

**Title:** Wheat yield forecasts using Landsat data  
**Authors:** J. E. Colwell, D. P. Rice, and R. F. Nalepka  
**Affiliation:** Environmental Research Institute of Michigan, Ann Arbor, Mich.  
**Meeting Date:** Ann Arbor, Mich., Environmental Research Institute of Michigan, 1977, p. 1245-1254  
**Contract or Grant Number:** Contract No. NASS-2389  

Leaf area index and percentage of vegetative cover, two indices of crop yield developed from Landsat multispectral scanning data, are discussed. Studies demonstrate that the Landsat indicators may be as highly correlated with winter wheat yield as estimates based on traditional field sampling methods; in addition, the Landsat indicators may account for variations in individual field yield which are not explainable by meteorological data. A simple technique employing early-season Landsat data to make wheat yield predictions is also considered.

J.M.B.
AGRICULTURE AND FORESTRY

01

A Continuing Bibliography (Issue 20)

JANUARY 1979

Results are reported for computer-assisted forest-land classification using the CCRS Image-100 supervised classification technique. The study was conducted at three Canadian test sites. The results from principal-components color enhancement revealed that logged-over, urban, power-line, and cultivated areas were easily distinguishable and that vegetation could be mapped. Poor results were obtained from unsupervised classification on the five identifiable forest-land classes with the exception of water. Computer-assisted classification using supervised classification algorithms was found to identify broad forest-land classes which may be subsequently used for further sampling by small-scale aerial photographs and ground surveys.

S.C.S.


The application of remote sensing technology in agronomy and pedology is discussed in terms of data collection and data interpretation. With reference to data collection, attention is given to wavelength-band selection as determined by the subject under study, and altitude selection as determined by the dimensions of the plot under study. Methods for data interpretation are outlined including analytical, statistical, and cartographic techniques.

S.C.S.


Landsat data have been computer processed in order to determine indices of growing conditions for general vegetation, cultivated areas, and specific crops such as spring wheat. Individual pixels are classified as to vegetation density and the biomass is calculated. Regression equations (obtained from biomass indices from various sites) are used to calculate predicted crop yields in terms of bushels per acre. A comparison is made between the actual distribution of classified pixels in spring wheat yields and the predicted distribution. It is found that the predicted values for final yield are within plus or minus 10 percent of the actual yields for ten out of eleven estimates made for various regions of Canada.

S.C.S.


Multispectral reflectance measurements are used to make quantitative predictions of chemical soil conditions. Data are collected from five parent materials from the air, on the ground, and in the laboratory. Spectral reflection curves are determined over the 400-1000 nm range and mean and range values are found. It is noted that percent carbon, iron, and exchangeable magnesium are most correlated with the spectral measurements. A curvilinear regression fitting an exponential function satisfactorily predicts carbon and exchangeable magnesium values whereas a straight linear function satisfactorily predicts iron values. The airborne, ground, and laboratory analyses are found to yield similar results.

S.C.S.


Consideration is given to the interpretation of Landsat imagery and ultra-small and large-scale aerial photography with reference to a multistage sampling design for forest regions. It is found that: (1) a multistage design incorporating sampling units based on variable probability is applicable to large-area inventories, (2) ultra-small, infrared, color aerial photographs may be used to estimate stand volumes for preparing forest cover and soil maps, and (3) large-scale photo sampling may partially replace extensive ground sampling when estimating timber volume, cut-over land, and habitat types.

S.C.S.


Multispectral reflectance measurements are used to make quantitative predictions of chemical soil conditions. Data are collected from five parent materials from the air, on the ground, and in the laboratory. Spectral reflection curves are determined over the 400-1000 nm range and mean and range values are found. It is noted that percent carbon, iron, and exchangeable magnesium are most correlated with the spectral measurements. A curvilinear regression fitting an exponential function satisfactorily predicts carbon and exchangeable magnesium values whereas a straight linear function satisfactorily predicts iron values. The airborne, ground, and laboratory analyses are found to yield similar results.

S.C.S.

Remote sensing techniques used to evaluate ground-level energy exchanges and the thermal characteristics of the ground cover are reviewed. Studies conducted at ground level, using an airborne PRT5 radiometer, and using a Daedalus scanner are described. The soil parameters which may be monitored are presented along with a thermal classification of the primary types of ground cover. Seasonal variations are described and a synoptic table is proposed for data interpretation.

S.C.S.

**A78-43336**  

LandSat data have been used in conjunction with aerial photography and field data to evaluate the rice-growing areas in the Camargue region of southern France. The data were collected from eight Landsat passages made in 1975 and aerial photographs taken at 1500 and 7000 m. It is found that optimal results are obtained using supervised classification techniques, multivariate observations, and methods employing linear discriminant functions.

S.C.S.

**A78-43342**  

Digital multispectral and multipolarization synthetic aperture radar have been used for vegetation classification in coastal wetlands regions. The basic components of the X-L radar system are the two-channel X-band (3.2 cm) and L-band (25.0 cm) radars. The two radar parameters are varied in the multiplexed system. The data are digitized by the ERIM hybrid optical-digital processor and seven classes are identified: inland H2O, coniferous trees, palmettoes and palm/secondary story, marsh grass, coastal marsh grass, sand and shell fragments, and dry grass and palmettoes.

S.C.S.

**A78-43347**  

**A78-44801**  

Multispectral aerial photographs of two river valleys near Tolaga Bay and Ruatoria, East Coast, North Island showed much better definition of soil boundaries of alluvial soils than conventional panchromatic photographs. The photographs were in four wavelength bands that approximate Landsat satellite passbands. They showed differences between parent materials and erosion patterns of hill country. Black and white prints of the infrared range produced more information on soil type separation than panchromatic photos, but they were inferior in erosion pattern detection. (Author)

**A78-47320**  

A light absorption model (LAM) for vegetative plant canopies has been derived from the Suits reflectance model. From the LAM the absorption of light in the photosynthetically active region of the spectrum (400-700 nm) has been calculated for a Pemigewasset wheat crop for several situations including (a) the percent absorption of the incident radiation by a canopy of LAI 3.1 having a four-layer structure, (b) the percent absorption of light by the individual layers within a four-layer canopy and by the underlying soil, (c) the percent absorption of light by each vegetative canopy layer for variable sun angle, and (d) the cumulative solar energy absorbed by the developing wheat canopy as it progresses from a single layer through its growth stages to a three-layer canopy. This calculation is also presented as a function of the leaf area index and is shown to be in agreement with experimental data reported by Kanemasu on Plainsman V wheat. (Author)

**A78-48005**  

The study for which the results are presented had these objectives: (1) to use Landsat data and computer-implemented pattern recognition to classify the major crops from regions encompassing different climates, soils, and crops. (2) to estimate crop areas for counties and states by using crop identification data obtained from the Landsat identifications; and (3) to evaluate the accuracy, precision, and timeliness of crop area estimates obtained from Landsat data. The paper describes the method of developing the training statistics and evaluating the classification accuracy. Landsat MSS data were adequate to accurately identify wheat in Kansas; corn and soybean estimates for Indiana were less accurate. Systematic sampling of entire counties made possible by computer classification methods resulted in very precise area estimates at county, district, and state levels. P.T.H.

**A78-51618**  

A 13.3 GHz scatterometer and a nadir-viewing radiometer-measuring reflected radiance in the Landsat bands were flown simultaneously over a number of fields near Ottawa containing eleven different forage crops. The purpose of the experiments was to compare the relative ability of the optical and microwave sensors to differentiate the various crop types, and to investigate the advantages of combining optical and microwave measurements for crop discrimination. Confusion matrices were calculated for both the optical and the microwave data. Microwave and optical sensors provide complementary information which, when combined, permit the most accurate classifications to be achieved. The better single sensor based on classification accuracy is a multipolarized optical sensor. It was found that the most significant features derivable from the scatterometer data were the dual-polarized scattering coefficients at nadir and the linear slopes of the scattering coefficients as a function of observation angle. (Author)

**A78-51619**  

Field spectroradiometer data at 10-nm intervals in the region of 350 to 1840 nm, from 1976 experimental field plots of wheat, oats, barley, fababean, soybean, and rapeseed, were analyzed statistically to assess discriminability among the crops. At early stages of plant growth, interference from soil reflectance was dominant. Analysis of the data obtained between early heading and early seed development showed similar spectral patterns among the crops and their cultivars. Unique differences were obtained among them at certain narrow bands in relation to the over-all mean radiance based on coefficients of variation. An index of discriminability, determined to assess separability of crops throughout the spectrum, was used to distinguish between two wheat cultivars at 950 and 1400 nm which corresponds to the water absorption region for leaves. (Author)
GLOBAL CROP PRODUCTION FORECASTING: AN

may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS (E79-10178; NASA-TM79545) Avail: NTIS HC A02/MF A01 CSCL 08F

N78-29536*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)

EVALUATION OF WAVELENGTH GROUPS FOR DISCRIMINATION OF AGRICULTURAL COVER TYPES
Ravindra Kumar Apr. 1978 13 p refs Submitted for publication (Grant NGL-15-005-112) (NASA-CR-157393: INPE-1210-PE/120) Avail: NTIS HC A03/MF A01 CSCL 02C

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

N78-29537*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)

EFFECTS OF SYSTEMIC AND NON-SYSTEMIC STRESSES ON THE THERMAL CHARACTERISTICS OF CORN
Ravindra Kumar, L. F. Silva, and M. E. Baer (Purdue Univ.) Jun. 1978 33 p refs Submitted for publication (Grant NGL-15-005-112) (NASA-CR-157391: INPE-1282-PE/138) Avail: NTIS HC A03/MF A01 CSCL 02C

Experiments were conducted on corn plants using a calibrated spectroradiometer under field conditions in the indium antimonide channel (InSb: 2.8 to 5.6 mm) and the mercury cadmium telluride channel (HgCdTe: 7 to 14 mm). A ground cover experiment, an experiment on nonsystemic corn plants, and an experiment on systemic-stressed corn plants were included. The average spectral radiance temperature of corn plant populations was found (1) to be statistically significantly different for four healthy corn plant populations, (2) to increase with increased blight severity, and (3) to be statistically significantly different for varying rates of nitrogen applications.

Author


The progress and problems in research to improve the Department of Agriculture's foreign crop forecasting system are discussed. The experiment uses satellite imagery from LANDSAT to measure how many acres of wheat are growing, and also uses weather data to estimate the yield. GRA


GLOBAL CROP PRODUCTION FORECASTING: AN

ANALYSIS OF THE DATA SYSTEM PROBLEMS AND THEIR SOLUTIONS

Data related problems in the acquisition and use of satellite data necessary for operational forecasting of global crop production are considered for the purpose of establishing a measurable baseline. For data acquisition the world was divided into 37 crop regions in 22 countries. These regions represent approximately 95 percent of the total world production of the selected crops of interest, i.e., wheat, corn, soybeans, and rice. Targets were assigned to each region. Limited time periods during which data could be taken (windows) were assigned to each target. Each target was assigned to a cloud region. The DDS was used to measure the success of obtaining data for each target during the specified windows for the regional cloud conditions and the specific alternatives being analyzed. The results of this study suggest several approaches for an operational system that will perform satisfactorily with two LANDSAT type satellites.

G.G.

N78-31481*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)

AUTOMATIC CLASSIFICATION OF REFORESTED PINUS SPP AND EUCALYPTUS SPP IN MOGI-GUACU, SP, BRAZIL USING LANDSAT DATA

The author has identified the following significant results. Single date LANDSAT CCTs were processed, by Image-100 to classify Pinus and Eucalyptus species and their age groups. The study area Mogi-Guacu was located in the humid subtropical climate zone of Sao Paulo. The study was divided into ten preliminary classes and featured selection algorithms were used to calculate, Bhattacharyya distance between all possible pairs of these classes in the four available channels. Classes having B-distance values less than 1.30 were grouped in four classes: (1) class PE - P. elliotti, (2) class PO - Pinus species other than P. elliotti, (3) class EY - Eucalyptus spp. under two years, and (4) class EO - Eucalyptus spp. more than two years old. The percentages of correct classification ranged from 70.9% to 94.12%. Comparisons of acreage estimated from the Image-100 with ground truth data showed agreement. The Image-100 percent recognition values for the above four classes were 91.62%, 87.80%, 89.89%, and 103.30%, respectively.
The **USE OF LANDSAT DATA TO IDENTIFY AND EVALUATE AREAS OF SUGAR CANE**

Nelson deJesusParada, Principal Investigator, Getulio Teixeira Batista, Antonio Tebaldi Tardin, Rene Antonio Novaes, Francisco Jose Mendonca, David Chung Liang Lee, and Sherry Chou Chen. 

**Channels 5 and 7 were best for natural vegetation, drainage patterns, and land use. Frequency ratio was the recommended index for use when analyzing a drainage pattern quantitatively.**

**SUMMARY**

**USE OF LANDSAT DATA TO IDENTIFY AND EVALUATE AREAS OF SUGAR CANE**

Nelson deJesusParada, Principal Investigator, Getulio Teixeira Batista, Francisco Jose Mendonca, David Chung Liang Lee, and Sherry Chou Chen. 

**Channels 5 and 7 were best for natural vegetation, drainage patterns, and land use. Frequency ratio was the recommended index for use when analyzing a drainage pattern quantitatively.**

**AGRESTE PROJECT: AGRICULTURAL RESOURCES INVESTIGATIONS IN NORTHERN ITALY AND SOUTHERN FRANCE**

A. Berg, Principal Investigator, G. Fiuma, S. Galli DeParatesi. 

**Recognition of rice varieties at the flowering stage by using airborne scanner data at low altitude (1500 m) seems to be feasible.**

**ANALYTICAL TECHNIQUES FOR THE STUDY OF SOME PARAMETERS OF MULTISPECTRAL SCANNER SYSTEMS FOR REMOTE SENSING**

E. R. Woszwell and George R. Cooper. Principal Investigators. 

**The concept of average mutual information in the received spectral random process about the spectral scene was developed.**

**ATLAS OF SELECTED CROP SPECTRA. IMPERIAL VALLEY CALIFORNIA**

Stephen G. Ungar, Principal Investigator. William Collins (Columbia Univ.), Jerry C. Coiner (Columbia Univ.), Dwight Egbert (General Telephone and Electronics), Richard Kiang (General Telephone and Electronics), Tina Cary (Columbia Univ.), Peter Coulter (General Telephone and Electronics), Nurit Landau (General Telephone and Electronics), Elaine Mathews (Columbia Univ.), Stephen Lytle (General Telephone and Electronics). 

**The concept of average mutual information in the received spectral random process about the spectral scene was developed.**

**Assessment of the damage caused by the frost of 1975 to coffee and wheat crops in the northwest of the state of Parana using Landsat images with automatic classification**

**Assessment of the damage caused by the frost of 1975 to coffee and wheat crops in the northwest of the state of Parana using Landsat images with automatic classification**

Nelson deJesusParada, Principal Investigator, Antonio Tebaldi Tardin, Carlos Vicente Barbieri Palestino, and Claudio Roland Spenenberg. 

**The concept of average mutual information in the received spectral random process about the spectral scene was developed.**
NATIONWIDE FORESTRY APPLICATIONS PROGRAM: PROCEDURE 1 APPLICABILITY TO RANGELAND CLASSIFICATION Final Report
C. A. Reeves, Principal Investigator Jun. 1978 52 p refs EREP
(Contract NAS9-15200)
(E78-10202; NASA-CR-151809; LEC-12174; D-63-1737-5335-02) Avail: NTIS HC A04/MF A01 CSCL 08F

The author has identified the following significant results. An assumption that short prairie grass and salt grass could be differentiated on aircraft photographs was inaccurate for the Weld County site. However, rangeland could be differentiated using procedure 1 from LACIE. Estimates derived from either random or systematic sampling were satisfactory. Level 1 features were separated and mapped, and proportions were estimated with accompanying confidence statements.

NATIONWIDE FORESTRY APPLICATIONS PROGRAM: TEN-ECOSYSTEM STUDY (TES) SITE 5 REPORT, KERSHAW COUNTY, SOUTH CAROLINA, REPORT 4
R. D. Dillman, Principal Investigator Jun. 1978 68 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-15200)
(E78-10203; NASA-CR-151813; LEC-11863) Avail: NTIS HC A04/MF A01 CSCL 13B

The author has identified the following significant results. The Kershaw County site, South Carolina, was selected to be representative of both the oak-pine ecosystem and the southeastern pine ecosystem. The following processing results have concluded that: (1) early spring LANDSAT data provide the best contrast between forest features; (2) level 2 forest features (softwood, hardwood, grassland, and water) can be classified with an accuracy of 70% + or - 5.7% at the 90% confidence level; (3) level 3 species classification was inconclusive; (4) temporal data did not provide a significant increase in classification accuracy of level 2 features, over single date classification to warrant the additional processing; and (5) training fields from only 10% of the site can be used to classify the entire site.

N78-31504*# Houston Univ., Tex.
LINEAR FEATURE SELECTION WITH APPLICATIONS
H. P. Decell, Jr. and L. F. Guseman, Jr., Principal Investigators (Texas A and M Univ., College Station) Jul. 1978 30 p refs EREP
(Contract NAS9-15543)
(E78-10206; NASA-CR-151820; Rept-70) Avail: NTIS HC A03/MF A01 CSCL 02C

N78-31505*# Environmental Research Inst. of Michigan, Ann Arbor.
(Contract NAS9-15476)
(E78-10207; NASA-CR-151754; ERIM-132400-7-L) Avail: NTIS HC A07/MF A01 CSCL 02C

N78-32525*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RED AND PHOTOGRAPHIC INFRARED LINEAR COMBINATIONS FOR MONITORING VEGETATION
Compton J. Tucker May 1978 37 p refs Submitted for publication (NASA-TM-79620) Avail: NTIS HC A02/MF A01 CSCL 08F

In situ collected spectrometer data were used to evaluate and quantify the relationships between various linear combinations of red and photographic infrared radiances and experimental plot biomass, leaf water content, and chlorophyll content. The radiance variables evaluated included the red and photographic infrared (IR) radiance and the linear combinations of the IR/red ratio, the square root of the IR/red difference, the vegetation index, and the transformed vegetation index. In addition, the corresponding green and red linear combinations were evaluated for comparative purposes. Three data sets were used from June, September, and October sampling periods. Regression analysis showed the increase utility of the IR and red linear combinations vis-a-vis the same green and red linear combinations. The red and IR linear combinations had 7% and 14% greater regression significance than the green and red linear combinations for the June and September sampling periods, respectively. The VI, TVI, and square root of the IR/red ration were the most significant followed closely by the IR/red ratio. Less than 6% difference separated the highest and lowest of these four IR and red linear combinations. The use of these linear combinations was shown to be sensitive primarily to the green leaf area or green leaf biomass.

N78-33507*# Instituto de Pesquisas Espaciais, Sao Paulo (Brazil).
DEVELOPMENT OF HEAVILY VEGETATED AREA IN BRAZIL (PLANETAMENTO DO PROJETO CERRADO)
Nelson deJesusPara, Principal Investigator, Hideyo Aoki, Joao Roberto dosSantos, and Vitor Celso deCarvalho Jan. 1978 24 p In PORTUGUESE Sponsored by NASA ERTS (E78-10157; NASA-CR-157268; INPE-1186-NTE/109) Avail: NTIS HC A02/MF A01 CSCL 08F
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.

Landsat data collected during 1975-1976 have been used in ecological studies conducted in southern Tunisia. Information has been gathered on major surface features, vegetation, and surface soil characteristics. Color-treated imagery has been used to create a zoning system based on homogeneous ecological parameters. S.C.S.

The natural environment of the Hashemite Kingdom of Jordan is discussed in terms of remote sensing observations. Landsat data was used for most of the imaging, whereby information was compiled on a scale of 1:250,000, and published on a scale of 1:1,000,000. Landsat pictures, i.e., color composites, were classified into a system of discrete boundaries with the aid of a Zeiss Jena Interpretoscope. The data (encompassing geology, hydrology, soils, vegetation, and conservation) were checked by on-site ground observations. Attention is given to the morphology and location of the various geological regions, e.g., desert sandstone, upland limestone, and lava flows, etc. D.M.W.

A Landsat MSS 1:250,000 survey of Murcia Province, Spain, is presented as an illustration of the usefulness of Landsat data for the mapping of semi-arid regions of developing countries, in general. The methodology of the survey is divided into two parts: pre-operational and operational. The pre-operational phase consists of a formulation of objectives and techniques, with special attention to the development of the classification scheme to be used. The operational phase involves the interpretation of specific data. After Ground Truth has been established, a final map can be produced. D.M.W.

N87-28588# Army Engineer Waterways Experiment Station. Vicksburg, Miss. GUIDANCE FOR APPLICATION OF REMOTE SENSING TO
The author has identified the following significant results. Two sets of urban test sites, one with 35 cities and one with 70 cities, were selected in the State, Sao Paulo. A high degree of correlation (0.96) was found between urban and areal measurements taken from aerial photographs and LANDSAT MSS imagery. High coefficients were observed when census data were regressed against aerial information (0.95) and LANDSAT data (0.92). The validity of population estimations was tested by regressing three urban variables, against three classes of cities. Results supported the effectiveness of LANDSAT to estimate large city populations with diminishing effectiveness as urban areas decrease in size.

Results from quantitative analysis show that airplane remotely sensed spectral data can be used to quantify and map an acid-waste dump in terms of its particulate iron concentration. These same data, however, could not be used to map the dump in terms of total suspended solids, organic suspended solids, or inorganic suspended solids concentrations. A single-variable equation using the ratio of band 2 (440 to 490 nm) radiance to band 4 (540 to 580 nm) radiance was used to quantify the iron concentration in the acid-waste dump. The acid waste that was mapped varied in age from freshly dumped to 3 1/2 hr. Particulate iron concentrations in the acid waste were estimated to range up to 1.1 mg/l at a depth of 0.46 m. A classification technique was developed to identify pixels in the data set affected by sun glitter.

Results from quantitative analysis show that airplane remotely sensed spectral data can be used to quantify and map an acid-waste dump in terms of its particulate iron concentration. These same data, however, could not be used to map the dump in terms of total suspended solids, organic suspended solids, or inorganic suspended solids concentrations. A single-variable equation using the ratio of band 2 (440 to 490 nm) radiance to band 4 (540 to 580 nm) radiance was used to quantify the iron concentration in the acid-waste dump. The acid waste that was mapped varied in age from freshly dumped to 3 1/2 hr. Particulate iron concentrations in the acid waste were estimated to range up to 1.1 mg/l at a depth of 0.46 m. A classification technique was developed to identify pixels in the data set affected by sun glitter.

Results from quantitative analysis show that airplane remotely sensed spectral data can be used to quantify and map an acid-waste dump in terms of its particulate iron concentration. These same data, however, could not be used to map the dump in terms of total suspended solids, organic suspended solids, or inorganic suspended solids concentrations. A single-variable equation using the ratio of band 2 (440 to 490 nm) radiance to band 4 (540 to 580 nm) radiance was used to quantify the iron concentration in the acid-waste dump. The acid waste that was mapped varied in age from freshly dumped to 3 1/2 hr. Particulate iron concentrations in the acid waste were estimated to range up to 1.1 mg/l at a depth of 0.46 m. A classification technique was developed to identify pixels in the data set affected by sun glitter.
03 GEODESY AND CARTOGRAPHY
Includes mapping and topography.

A78-43306

A study has been made to determine the applicability of using Landsat data for the mapping of the forest cover in Quebec, Canada. The two-site study (Anticosti Island and the Laurentian Plateau) was based on photographic records and a mixed classification technique. The Anticosti Island study indicates that various types of forest cover, referred to as orphaned and forested areas, and damaged forest land may be identified. The Laurentian Plateau study indicates that deciduous and coniferous areas may be distinguished along with extensive deciduous and coniferous areas, and damage forest land may be identified. The Laurentian Plateau study indicates that deciduous and coniferous areas may be distinguished along with post-damage stages of development. Factors influencing reflectance are identified as atmospheric conditions (such as the amount of water vapor) and conditions inherent to the ground surface (such as the slope exposure).

S.C.S.

A78-43311

A semi-automatic interpretation method for Landsat data has been used to establish land-occupation and land-use maps in the southern James Bay area. The data included Landsat imagery, aerial photographs, and maps on various scales. Based on the multispectral analyzer display system, which utilizes the maximum likelihood algorithm and the unsupervised classification method, information categories were identified including clearcut zones, upgrowth zones, hardwood regions, resinous regions, peat bogs, and infrastructures.

S.C.S.

Landsat imagery has been used along with topographic data for land-use and land-cover identification. Based on the WATMAP software system, slope and slope-orientation data for square grid elements approximately corresponding to pixels are given. The WATMAP data is then superimposed on the Landsat data using an affine transformation. For maize, a distinct correlation is found between reflectance and slope and slope orientation. The technique yields accuracy to within 76-86% for samples of 100 field data per class.

S.C.S.

A78-45924

Laser ranging systems operated from space are capable of detecting motions on earth in the 2-5 cm range. Attention is given to the detection of crustal motion, specifically along the San Andreas fault, and a mathematical model is presented for a geometric mode system consisting of at least five grid and three distant (fundamental) stations to be operated with airborne and spaceborne lasers. The ground stations are designed to operate unattended, and to work in conjunction with Shuttle-based hardware to become operational in 1982. The Shuttle laser ranging system is expected to provide survey data within a period from one to two weeks, with a resurvey capability to be used as required.

D.M.W.

N78-29543
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)
DETERMINATION OF VARIOUS TOPOGRAPHIES USING PHOTOGRAPHIC TEXTURE ANALYSIS OF LANDSAT IMAGES [DETERMINACAO DE VARIACOES TOPOGRAFICAS ATRAVES DA ANALISE DE TEXTURA FOTOGRAFICA DE IMAGENS LANDSAT]
Evelyn Marcia Leao DeMoraesNovo and Armando Pacheco DosSantos Jul. 1977 31 p refs In PORTUGUESE: ENGLISH summary (INPE-1077-NTE/103) Avail. NTIS HC A03/MF A01

The relationship between the texture of LANDSAT images and topographic variation was studied. Topographic data were collected from LANDSAT images and topographic maps. A roughness index was used to represent image texture. This index represents the tonal variation within a 0.5 cm x 0.5 cm grid. Declivity data were collected from topographic maps at different scales. The relationship showed the possibility of characterizing topographic conditions by analyzing the texture of LANDSAT images.

J.M.S.

N78-29545
Army Engineer Topographic Labs., Fort Belvoir, Va.
NEAR REAL TIME APPLICATION OF DIGITAL TERRAIN DATA IN A MINICOMPUTER ENVIRONMENT
James R. Janczatis and William R. Moore Apr. 1978 30 p (AD-A054008; ETL-0142) Avail. NTIS HC A03/MF A01 CSCL 08/2

Two developments have combined to significantly impact the growing number of applications dependent upon digital terrain elevation data, mathematical terrain modeling, and minicomputer growth. Digital representation of terrain form has previously required vast amounts of mass storage with the relatively slow speed data access associated with large databases. A technique has been developed for compact digital storage of elevation data which also decreases the data access times significantly, a polynomial terrain model. Also, the minicomputer industry has been experiencing dramatic increases in the processing speeds and digital storage capabilities along with steadily declining costs. Preliminary results of a recently initiated study into the impact of these developments on utilization of digital terrain elevation data is presented.

Author (GRA)
A satellite-borne laser ranging system is proposed that is capable of making highly precise geodetic measurements over baselines ranging from a few tens of kilometers to several hundred kilometers. The precision with which crustal strain rates are derived from measurements made with this system is analyzed by using simple site configurations, intersite distances of about 25-70 kilometers, and measurement programs ranging from a few years to fifteen years. It is concluded that precisions of several, parts in 10 to the 9th power per year are achievable. Compared to the expected shear strain rates of about 7 x 10 to the minus 7th power yr/1, this produces very favorable signal-to-noise ratios.

G.G.
04 GEOLGY AND MINERAL RESOURCES

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

A78-43310 # Surficial geology in the Pas area of Manitoba - An application of digital Landsat data. V. Singhroy (Department of Mines, Resources and Environmental Management, Mineral Resources Div., Winnipeg, Manitoba, Canada) and B. Bruce (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 57-66, 6 refs. The CCRS-100 system was used to distinguish six large-scale biophysical land categories in the Pas region of Manitoba, Canada: ablation till, black spruce bogs, alluvial deposits, fens, water bodies having a high suspended-sediment content, and shallow marsh and bog lakes. Both supervised and unsupervised techniques were employed. An extensive field program evaluated the Landsat data in order to perform superficial geological mapping.

S.C.S.

A78-43331 # Mapping mine wastes with Landsat images. H. D. Moore, J. H. Adams, and A. F. Gregory (Gregory Geoscience Ltd., Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 294-304, 23 refs. Landsat imagery has been used for mapping mine wastes in Canada including tailings, spoil or transported overburden, slag, and waste rock. The Landsat imagery provides information on the location and area of mine dumps, the percent of vegetative cover, the location and size of mine-related water bodies, the location of deciduous and coniferous cover, and environmental changes with time. The study indicates a total area of mine wastes of 47,233 acres which represents 0.004% of the surface area of Canada. Of this area 46.8% is overburden, 37.3% is tailings, 15.3% is waste rock, and 0.6% is slag. Approximately 14.8% of the wastes have vegetative cover.

S.C.S.

A78-43348 # The use of remote sensing /infrared thermal profiles and photofacsimiles/ for the geological reconnaissance of dam sites - Four specific cases (Emploi de la télédétection - thermographies et photographies en couleurs infrarouges - dans les reconnaissances géologiques de site de barrages: Exemple de quatre cas précis). L. Caillon, J. C. Gros, Ch. Béliard, and P. Ch. Levéque (Bordeaux I, Université, Talence, Gironde, France). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 516-531, 8 refs. In French.

A78-43639 # The geological interpretation of the Tibesti from Landsat-1 imagery /Republic of Chad/ - Explanations regarding the map Tibesti 1:1,000,000 (Geologische Interpretation des Tibesti nach Aufnahmen von Landsat-1 /Republik Tschech/ - Erläuterungen zur Karte Tibesti 1:1,000,000). F. K. List, D. Helmcke, B. Meissner (Berlin, Freie Universität, Berlin, West Germany), G. Pöhlimann (Berlin, Technische Fachhochschule, Berlin, West Germany), and W. N. Roland (Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, West Germany). Bildmessung und Luftbildwesen, vol. 46, July 1, 1978, p. 139-145. 40 refs. In German.

The launching of the Landsat-1 satellite in July 1972 made it for the first time possible to obtain on a routine basis repeatable small-scale multispectral pictures of the entire surface of the earth. The great number of geomorphological and photogeological studies conducted in the central part of the Tibesti mountains since 1964 provided an opportunity to use this arid region as a test area for a study concerning the applicability of satellite picture mapping. The objectives of the reported investigation are related to a study of the information provided by a geological satellite picture interpretation involving a scale of 1:1,000,000, taking into account for a comparison aerial-photograph evaluations involving a scale of 1:50,000 and ground-based terrain studies.

G.R.


Consideration is given to mineral exploration on the basis of remotely sensed data. Landsat applications are reviewed and the exploration for fossil and nuclear fuels from orbital altitudes is explored. Remote sensing projects for energy development are outlined along with geochemical mapping by spectral ratioing methods. Remote sensing projects in Brazil and India are noted.

S.C.S.

A78-53377 # Foreseeable energy and mineral resource problems. W. L. Smith (Michigan, Environmental Research Institute, Arlington, Va.). In: Remote-sensing applications for mineral exploration. Stroudsburg, Pa., Dowden, Hutchinson and Ross, Inc., 1977, p. 9-27. 27 refs. The paper surveys and anticipated mineral resource requirements noting the U.S. dependence on foreign sources. Projected energy resources are discussed with reference to oil and gas liquids, coal, nuclear energy, and geothermal power. Landsat projects in monitoring surface water, soil moisture, snowpack, and for resource mapping are discussed. Remote sensing for nonfuel minerals such as beryllium, cobalt, molybdenum, tungsten, and zinc is considered.

S.C.S.

A78-53378 # Gap between raw remote-sensor data and resources and environmental information. B. F. Grossling and J. E. Johnston (U.S. Geological Survey, Reston, Va.). In: Remote-sensing applications for mineral exploration. Stroudsburg, Pa., Dowden, Hutchinson and Ross, Inc., 1977, p. 28-41. Attention is given to the economic resources necessary for developing remote sensing projects. Institutional funding for the collection of resource information is discussed. The interpretation of raw remote-sensor data is discussed from the point of view of user orientation. Geological mapping is reviewed noting the choice of map scale and two- versus three-dimensional geology. Oil exploration on the basis of remotely sensed data is considered along with a steel-mill project and an agrarian reform project.

S.C.S.

color composites noting the applications of each in agriculture, forestry and range, water resources, geology, land use, and marine resources. A series of Landsat images is presented noting forest regions, burn scars, vegetated areas, and flood regions. A geological map compiled from an analysis of Landsat imagery is presented along with a strip-mine map also constructed from the data of Landsat images. Landsat data is further discussed with reference to mineral exploration, earthquake-zone investigations, and geothermal surveys.

A78-53380  

Five categories have been identified as surficial indicators of possible mineral resources: topography, igneous and volcanic features, lineaments and geological structure, mineralogical-lithological association, and stratigraphic sequence. The characteristics of obscured deposits are discussed noting blind, leached, zoned, and truncated orebodies and ores obscured by post-ore concealment. Remote-sensor data are discussed in terms of the analysis of surface characteristics and the analysis of data products.

A78-53381  

Observations of the earth from remote-sensing platforms are discussed noting the NASA Earth Resources Aircraft Program, Earth Resources Technology Satellite program, and the Earth Resources Experiments Package. Techniques for geological mapping are described including automatic mapping, visual interpretation, band selection, radar, band combination, and image enhancement.

A78-53382  

The paper discusses the application of remotely sensed data from orbital satellites to the exploration for fossil and nuclear fuels. Geological applications of Landsat data are described including map editing, lithologic identification, structural geology, and mineral exploration. Specific results in fuel exploration are reviewed and a series of related Landsat images is included.

A78-53383  

The application of remote sensing techniques to energy development projects is considered noting the nature of the data collected and the various types of remote sensors available, such as photog-raphy devices, infrared scanners, radiometers, and radar systems. Processes for converting sensor data into the necessary form are described including magnification, restoration, image transfer, enhancement, and image coding. Several types of static hardware and image data processors are listed.

A78-53384  

The procedure for the digital enhancement of Landsat MSS data for mineral exploration is outlined. Computer-compatible tapes are discussed noting their dynamic range, precision, repeatability, and resolution. Several digital image processing operations are described by means of actual images. They include contrast enhancement, density slicing, digital photomosaic, and logarithmic ratioing.

A78-53385  

The paper discusses the application of spectral ratioing techniques to geochemical mapping. It is noted that multispectral scanners collecting data in the 0.4-2.5-micron range are particularly important for studying transition-metal ions and that the 8-14-micron region yields information on silicate rock types. Compositional information in image form may be mapped from spectral ratio images from aircraft and satellite scanners.

A78-53386  

The impact of Landsat programs in less-developed areas is discussed with reference to the preparation of base maps and computer-compatible tapes. A potential exploration procedure is outlined noting the selection of areas for exploration, surveys of geological data, reconnaissance, geological mapping, test drilling, and subsurface exploration.

A78-53387  

Landsat imagery has been used for the analysis of geological structures including anticlinal and synclinal folds, lineaments, fractures, and faults. Structural data may be applied for mineral exploration, the study of thermal springs, and the identification of regions of hydrothermal alteration.

A78-53388  

Three areas of Brazil have been chosen for the application of Landsat imagery in geological studies: the Sao Domingos Range, the Pocos de Caldas region, and the area of the Middle Araguaia and Tocantins Rivers. Structural information extracted from the data has been used to evaluate the geological evolution of north-central Brazil and the physical properties of the lithosphere.


The author has identified the following significant results. For the first time the regional geological units are given. Faults, fractures, and folds are included, as well as drainage lines which help to visualize the environmental impact of the Qattara project for electric power generation and to assess the regional questions involved in its implementation.


GEOLOGY OF KHARGA DAKHLA OASES AREA. WESTERN DESERT, EGYPT. FROM LANDSAT-1 SATELLITE IMAGES. Cairo (Egypt). E. M. ElShazly, M. A. Abdel-Hady, and M. S. Dhanju (Indian Space Research Organization, Space Applications Center, Ahmedabad, India). In: Remote-sensing applications for mineral exploration.


The article surveys the environmental monitoring of mineral-related industries on the basis of remote-sensor data. Attention is given to various imaging systems including camera systems and to the characteristics of various aerial films and radiometers. The remote sensing of air, land, and water quality is discussed. A series of images is presented including those depicting strip mining, oil seepage, thermal and infrared images, radiometric images, and associated thermal contour maps.

S.C.S.


Stroudsburg, Pa., Dowden, Hutchinson and Ross, Inc., 1977, p. 363-388. 8 refs.

The article surveys the environmental monitoring of mineral-related industries on the basis of remote-sensor data. Attention is given to various imaging systems including camera systems and to the characteristics of various aerial films and radiometers. The remote sensing of air, land, and water quality is discussed. A series of images is presented including those depicting strip mining, oil seepage, thermal and infrared images, radiometric images, and associated thermal contour maps.

S.C.S.

A78-53390 Studies utilizing orbital imagery of India for geology and land use. R. D. Sharma (Indian Space Research Organization, Bangalore, India), B. N. Raina (Indian Photo Interpretation Institute, Dehra Dun, India), and M. S. Dhanju (Indian Space Research Organization, Space Applications Center, Ahmedabad, India). In: Remote-sensing applications for mineral exploration.

A78-53389

The author has identified the following significant results. The delineation of the geological units and geological structures through image interpretation, corroborated by field observations and structural analysis, led to the discovery of new iron ore deposits. A new locality for iron ore deposition, namely Gebel Qalaiman, was discovered, as well as new occurrences within the already known iron ore region of Bahariya Oasis.

N78-29533*# Stanford Univ., Calif. School of Earth Sciences
HCM: SOIL MOISTURE IN RELATION TO GEOLOGIC STRUCTURE AND LITHOLOGY, NORTHERN CALIFORNIA


N78-29540*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)
PROJECT GEOLOGICAL MAP TO THE MILLIONTH SCALE


Methodologies for the systematic use of remote sensing techniques for regional geological mapping are reported. A large amount of new geological information was obtained permitting a better understanding of structural, tectonic and stratigraphical problems. The results obtained are important for delineating areas of mineral deposits.

F.O.S.
REMOTE SENSING APPLIED TO REGIONAL GEOLOGICAL MAPPING IN THE SAO FRANCISCO RIVER AREA

Athos Ribeiro Dos Santos, Paulo Roberto Meneses, and Ubiratan Porto Dos Santos. Sep. 1977 181 p refs. In PORTUGUESE; English summary

INPE-1111-TPT/064 Avail: NTIS HC A09/MF A01

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

COLLECTED SUMMARIES OF WORKS DEALING WITH THE APPLICATION OF LANDSAT IMAGERY IN THE SURVEY OF MINERAL RESOURCES

Nelson de Jesus Parada, Principal Investigator. Apr. 1977 25 p

Sponsored by NASA ERTS

(E78-10191; NASA-CR-157381; INPE-1010-NTE/080) Avail: NTIS HC A02/MF A01 CSCL 08G

IN ALABAMA

Geological Survey, University, Ala.

REMOTE SENSING OF STRIPPABLE COAL RESERVES AND MINE INVENTORY IN PART OF THE WARRIOR COAL FIELD IN ALABAMA Final Report

Francis E. Evans, Jr., C. Daniel Sapp, and Peter A. Boone. Jul. 1978 128 p refs

Information acquired from NASA’s Earth Resources Office was used to analyze and map existing surface mines in a four-quadrangle area in west central Alabama. Using this information and traditional methods for mapping coal reserves, an estimate of remaining strippable reserves was derived. Techniques for the computer analysis of remotely sensed data and other types of available coal data were developed to produce an estimate of strippable coal reserves for a second four-quadrangle area. Both areas lie in the Warrior coal field, the most prolific and active of Alabama’s coal fields. They were chosen because of the amount and type of coal mining in the area, their location relative to urban areas, and the amount and availability of base data necessary for this type of study.

J M S

THE ANOMALOUS COLORATION OF ALTERED ROCKS ASSOCIATED WITH URANIUM OCCURRENCES IN SANDSTONE AND ITS DETECTION BY REMOTE SENSING METHODS. VOLUME 1


(Contract NAS7-100)

(NASA-CR-157600; JPL-Pub-78-66-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 08G

THE PRINCIPAL CLAY MINERAL PRESENT IN THE DEPOSITS IS MONOMORILLONITE. STATISTICAL ANALYSIS OF THE FIELD DATA WAS PERFORMED USING A STEPWISE LINEAR DISCRIMINANT FUNCTION ANALYSIS COMPUTER PROGRAM THAT DETERMINES WHICH COMBINATIONS OF INPUT WAVELENGTH BANDS PROVIDE BEST SEPARATION OF SPECIFIED GROUPINGS OF DATA. ALTERED AND UNALTED ROCKS COULD BE REPEATED WITH 95% ACCURACY USING SPECTRAL DATA INCLUDING ALL WAVELENGTH BANDS. OF THE SATELLITE-SIMULATED WAVELENGTH REGION TESTS, LANDSAT D BANDS GAVE THE BEST CLASSIFICATION ACCURACY.

A R H

THE PRINCIPAL CLAY MINERAL PRESENT IN THE DEPOSITS IS MONOMORILLONITE. STATISTICAL ANALYSIS OF THE FIELD DATA WAS PERFORMED USING A STEPWISE LINEAR DISCRIMINANT FUNCTION ANALYSIS COMPUTER PROGRAM THAT DETERMINES WHICH COMBINATIONS OF INPUT WAVELENGTH BANDS PROVIDE BEST SEPARATION OF SPECIFIED GROUPINGS OF DATA. ALTERED AND UNALTED ROCKS COULD BE REPEATED WITH 95% ACCURACY USING SPECTRAL DATA INCLUDING ALL WAVELENGTH BANDS. OF THE SATELLITE-SIMULATED WAVELENGTH REGION TESTS, LANDSAT D BANDS GAVE THE BEST CLASSIFICATION ACCURACY.

A R H

THE PRINCIPAL CLAY MINERAL PRESENT IN THE DEPOSITS IS MONOMORILLONITE. STATISTICAL ANALYSIS OF THE FIELD DATA WAS PERFORMED USING A STEPWISE LINEAR DISCRIMINANT FUNCTION ANALYSIS COMPUTER PROGRAM THAT DETERMINES WHICH COMBINATIONS OF INPUT WAVELENGTH BANDS PROVIDE BEST SEPARATION OF SPECIFIED GROUPINGS OF DATA. ALTERED AND UNALTED ROCKS COULD BE REPEATED WITH 95% ACCURACY USING SPECTRAL DATA INCLUDING ALL WAVELENGTH BANDS. OF THE SATELLITE-SIMULATED WAVELENGTH REGION TESTS, LANDSAT D BANDS GAVE THE BEST CLASSIFICATION ACCURACY.

A R H

THE PRINCIPAL CLAY MINERAL PRESENT IN THE DEPOSITS IS MONOMORILLONITE. STATISTICAL ANALYSIS OF THE FIELD DATA WAS PERFORMED USING A STEPWISE LINEAR DISCRIMINANT FUNCTION ANALYSIS COMPUTER PROGRAM THAT DETERMINES WHICH COMBINATIONS OF INPUT WAVELENGTH BANDS PROVIDE BEST SEPARATION OF SPECIFIED GROUPINGS OF DATA. ALTERED AND UNALTED ROCKS COULD BE REPEATED WITH 95% ACCURACY USING SPECTRAL DATA INCLUDING ALL WAVELENGTH BANDS. OF THE SATELLITE-SIMULATED WAVELENGTH REGION TESTS, LANDSAT D BANDS GAVE THE BEST CLASSIFICATION ACCURACY.
determine the relationships of various clay materials to mass movements. Each site was either designated as stable or assigned to one or more of the following categories: debris avalanche, debris flow, slump, earthflow, creep. All clay samples were analyzed by X-ray diffraction, and certain selected samples were analyzed by differential thermal analysis and/or electron microscopy. The more stable sites occur either at high elevations, with poorly formed soils having minimal clay development; or at low elevations, with relatively well-drained soils containing kaolinite, dehydrated halloysite, chloritic intergrades, and microaggregates bound by amorphous materials.

Dissert. Abstr.

N78-33504 Dartmouth Coll., Hanover, N.H.
MAPPING ULTRAMAFIC ROCKS BY COMPUTER ANALYSIS OF DIGITAL LANDSAT DATA Ph.D. Thesis
Gerald George Carlson 1978 277 p
Avail: Univ. Microfilms Order No. 7816101
A new algorithm, PROBLYMAP, was developed to classify digital LANDSAT data for the purpose of mapping geology or terrain type. The algorithm assigns to each pixel a set of probabilities belonging to each terrain type. An important feature of this algorithm is that the classification of a pixel is influenced not only by its own probabilities but also by those of its eight adjacent neighbors. The main application of the algorithm was the mapping of the suite of ultramafic and mafic rocks and related sediments in the desert environment of the Oman Mountains, Sultanate of Oman. The resulting classification map shows good agreement with the best ground truth available, which includes a geology map at 1:20,000 and 1:50,000 black and white air photos. Using training sites from three known copper deposits, 180 other gossan zones were identified within the gabbro/basalt sequence.

Dissert. Abstr.

David P. Gold, Principal Investigator Dec. 1977 65 p refs
Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-22822) (E78-10155; NASA-CR-156815) Avail: NTIS HC A04/MF A01 CSCL 088
The author has identified the following significant results. This study has shown that subtle variations in fold axes, fold form, and stratigraphic thickness can be delineated. Many of the conclusions were based on extrapolation in similitude to different scales. A conceptual model was derived for the Tyrone-Mount Union lineament. In this model, the lineament was the morphological expression of a zone of fracture concentrations which penetrated basement rocks and may have acted as a curtain to regional stresses or as a domain boundary between uncoupled adjacent crustal blocks.

N78-33519 Texas Instruments, Inc., Dallas.
MANUAL FOR THE APPLICATION OF NURE 1974-1977 AERIAL GAMMA-RAY SPECTROMETER DATA
D. F. Saunders and M. J. Potts Sep. 1977 184 p
Instructions for the interpretation and application of high-sensitivity aerial gamma-ray spectrometer data in uranium exploration are presented. Particular emphasis is on the first 10 radiometric surveys performed under the National Uranium Resource Evaluation program to map regional distributions of near-surface natural radionuclides. The fundamentals of uranium geology and geochemistry along with interpretive approaches which may be used to identify statistically and geochemically significant uranium anomalies and uraniumiferous provinces are outlined. Follow-up prospecting methods are summarized along with guides to recent literature. Specific suggestions are made as to interpretive approaches and applicable follow-up prospecting procedures tailored to fit the data characteristics and general environment of the aerial gamma-ray spectrometer surveys. ERA

N78-33644 Arkansas Univ., Fayetteville.
PRELIMINARY GEOLOGIC EVALUATION OF L-BAND RADAR IMAGERY: ARKANSAS TEST SITE Final Report
The relatively small angles of incidence (steep depression angles) of the L-band system provide minimal shadowing on terrain back-slopes and considerable foreshortening on terrain fore-slopes which sacrifice much of the topographic enhancement afforded by a more oblique angle of illumination. In addition, the dynamic range of the return from vegetated surfaces is substantially less for the L-band system, and many surface features defined primarily by subtle changes in vegetation are lost. In areas having terrain conditions similar to those of northern Arkansas, and where LANDSAT and shorter wavelength aircraft radar data are available, the value of the JPL L-band imagery as either a complimentary or supplementary geologic data source is not obvious.

L.S.
05

OCEANOGRAPHY AND MARINE
RESOURCES

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

A78-43315 # Ocean information and management systems.
L. W. Morley, A. K. McQuillan (Canada Centre for Remote Sensing,
Ottawa, Canada), and D. J. Clough (Waterloo, University, Waterloo,
Ontario, Canada). In: Canadian Symposium on Remote Sensing, 4th,
Quebec, Canada, May 16-18, 1977, Proceedings.

Management systems for ocean surveillance are discussed with reference to satellites, aircraft, ship, data-buoy, and fixed land- and
ocean-stages providing multilevel data integration. Areas requiring particular surveillance are identified as renewable resources (e.g.,
fisheries), nonrenewable resources (e.g., oil, gas, minerals), marine-environment protection, navigation control, and ocean-service activi-
ties (e.g., forecasting, rescue). Various data-generating subsystems are outlined such as sensors (including synthetic aperture radar),
telemetry methods to transmit data from sensors to receivers, and
commercial networks for electronic data distribution. Cost-effective
aspects of mixed surveillance systems are considered along with predicted gross benefits for environmental surveillance systems to the
year 2000.

S.C.S.

A78-43320 # Thermal studies of the Grand Banks Gulf
Stream slope using airborne radiation thermometers and satellite
data. H. G. Ketchen (International Ice Patrol), Governors Island,
N.Y., P. E. La Violette (U.S. Navy, Naval Ocean Research and
Development Activity, Bay St. Louis, Miss.), and R. D. Worsfold
(Newfoundland, Memorial University, St. John's, Canada). In:
Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May
16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space
Institute, 1977, p. 113-124.

Two correction techniques to account for atmospheric
attenuation are evaluated: the Pickett method which uses a correction
equation derived by multiple regression, and the atmospheric
environment service method which determines instrument drift, plots
an environmental correction graph, and applies a correction factor
for errors due to the water vapor mass below the aircraft. It is concluded that the correlation of the three data sources constitutes a
feasible method for determining iceberg deterioration rates.

S.C.S.

A78-43324 # Diurnal temperature variations and their use-
fulness in mapping sea ice from thermal infrared imagery. J. Cihar
and K. P. B. Thomson (Canada Centre for Remote Sensing, Ottawa,
Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec,

An 8-14-micron thermal infrared scanner and a PRT-5 were
flown at 380 m asl at sunset and in the afternoon over the Beaufort Sea
in order to measure ice surface temperature changes. The scanner
magnetic tape was used to produce a black and white transparency of
the recorded and reference signals. A gray level stepwedge was used
to relate film density to voltage and surface temperature. It was
found that solar radiation dominates the surface temperature
distribution during the afternoon. The surface temperature patterns
at sunset reflected the spatial thermal resistivity fluctuations of
ice-snow thickness combinations. The difference between measured
temperatures represents the combined effect of solar radiation and
heat passing upward from the ice-water boundary. It is observed that
daytime or nighttime surface temperature distributions may be
useful in mapping from high-resolution thermal infrared imagery.

S.C.S.

A78-43339 # Microwave sensing of sea surface wave patterns.
J. F. R. Gower (Institute of Ocean Sciences, Victoria, British
Columbia, Canada). In: Canadian Symposium on Remote Sensing,
4th, Quebec, Canada, May 16-18, 1977, Proceedings.

Sea-surface wave patterns in the northeast Pacific have been monitored by the GEOS-3 altimeter and airborne synthetic aperture
radar. Waveheight values obtained from the altimeter are compared
to surface truth measurements and weather reports. An accuracy to
within plus or minus one meter is found. When the measurements are
processed by a technique based on a pulse-variation model and which
compensates for timing and tracking loop errors, accuracy to within
0.5 meter is found.

S.C.S.

A78-43340 # A joint topside-bottomside remote sensing
experiment on Arctic sea ice. P. Wadhams (Scott Polar Research
Institute, Cambridge, England) and R. T. Lowry (Canada Centre for
Remote Sensing, Ottawa, Canada). In: Canadian Symposium on
Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceed-
ings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p.

The ice cover on the Arctic Ocean has been studied simulta-
neously from above by laser and from below by sonar in order to
determine the relationship between the distributions of ridge height and
keel draft. Results are presented for rms keel drafts as a function of
the mean number of keels per km of track, the probability density
function of ice drafts from the first 270 km of track, the probability
density function of ice drafts from 90 km sections of track, and the
distribution of surface ridge heights.

S.C.S.

A78-43343 # Radar techniques in the measurement of float-
ing ice thickness. R. H. Goodman, E. Outcault, and B. B. Narod
(Innovative Ventures, Ltd., Calgary, Alberta, Canada). In: Canadian
Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18,
1977, Proceedings. Ottawa, Canadian Aeronautics and Space
Institute, 1977, p. 459-468. 8 refs. Research supported by the National Research Council of Canada.

Two models of airborne downward looking radars have been
used to measure sea ice thicknesses. An experimental 36 cm high
power directional radar developed at the University of British
Columbia, and a GSSI ‘ESP’ radar were mounted on a Puma
helicopter to measure ice thicknesses off the Labrador coast. The
capabilities of each system were investigated to measure sea ice
thickness. The 36 cm radar’s capabilities were studied with particular
application to thick multiyear ice and iceberg measurements, while
the GSSI radar's capabilities were investigated with emphasis on the measurement of thinner ice, below the minimum range of the 36 cm radar. Typical data will be presented and analyzed. (Author)


Using the ERIM optical/digital data correlator, synthetic aperture radar (SAR) imagery has been used for studies of the ocean. Procedures for correcting radar data for geometric distortion and radiometric nonuniformity of imagery are outlined. The influence of wave train movement on the design of a Seasat correlator is evaluated. Techniques for calculating the two-dimensional Fourier transform of an SAR image are presented along with the necessary radar parameters for specific surveillance tasks. These tasks include deep-water waves, in-shore waves and the surf zone, and ships located in at least 10 m of water. Wave-imaging mechanisms are described with reference to a velocity modulation model, radar cross-section models, and the tangent plane model. S.C.S.


A radiometer has been designed for the remote sensing of ocean color in order to determine chlorophyll content. Upwellings and downwellings are simultaneously measured at 486, 525, 550, and 600 nm. Calculations of albedo differences at two wavelengths are used to relate ocean color to optical characteristics and to eliminate distortions caused by surface reflection and atmospheric disturbances. Color variations are noted to be related to the cycle of coastal upwellings. Experiments indicate that factors such as the vertical gradients of phytoplankton, water turbidity, and the discontinuity of chlorophyll content relative to depth influence the results. S.C.S.


An important objective of remote sensing in the case of marine investigations is related to a mapping of substances found in the water close to the surface of the sea. The employment of the multispectral scanner as measurement device provides information regarding the type and concentration of a substance on the basis of the spectrum of the radiation which is reflected by the water. In accordance with their optical characteristics, the substances to be studied can be divided into three groups, including dissolved organic substances, suspended matter, and phytoplankton. Attention is given to signal sources, the dependence of the wanted signal on the concentration of the substances, and the effect of disturbing signal sources.


The measured time between the transmission and return of 13.9 GHz radar pulses from the GEOS 3 satellite (at a mean altitude of 844.5 km and an inclination of 114 deg 52 min) is used to determine the thickness of the Greenland ice cap, with an accuracy in surface elevation on the order of 2 m. Attention is given to changes in ice thickness as an indicator of climatic change in general, and change in mean sea level in particular. Each elevation data point obtained by the satellite represents an average along 0.67 km of ground track, and three-dimensional maps are presented to illustrate the data. D.M.W.


The use of a microprocessor for data acquisition and preprocessing is described and illustrated by the example of a microprocessor-controlled shipborne ocean probe system that measures ocean depth, temperature, electrical conductivity, optical attenuation, and speed of sound. The system makes use of peripheral equipment including a digital magnetic tape unit, X-Y-plottter, numerical display, and printer. The basic hardware of the system consists of a microcomputer 8080 with 3 K PROM and 1 K RAM. The structure of the multiprobe service routine is shown, and programs for calculating polynomials, salinity, and taigents are given. P.T.H.


The book deals with questions associated with the development of a theory that may serve as a basis for designing maritime stations of electromagnetic geophysical exploration. A new theory, based on the consideration of the slow motion of the sea, is proposed, and its range of applicability is identified. Theories are developed from contactless magnetic-field emitters and for the contactless measurement of low-frequency electric fields. Promising system geometries are analyzed. The generalized properties of electric fields are formulated, and possible means of reproducing them are discussed. V.P.

A78-48740 Airborne remote sensing experiment /ocean temperature and color/ in the Straits of Dover (Expérience aéroportée de télédétection /température et couleur de la mer/ dans le détroit du Pas de Calais). M. Viollier, P. Lecomte (Lille I, Université,

Measurements of water color and of various chemical, biological, and physical properties were obtained at 73 hydrographic stations in Galway Bay and other waters off the west coast of Ireland during the late summer and autumn of 1977, and a strong correlation was found between color and surface salinity and also between color and the concentration of dissolved organic matter. The data were obtained in accord with a version of the 'sea-truth' protocol adopted for an earlier 'Ocean Color Scanner' experiment, and the results suggest that images transmitted by this multispectral scanner could help identify and delineate runoff-influenced waters. Techniques for determining water color are discussed, and a positive correlation between summed UV absorbance of a surface sample and the 'yellowness' (presumably representing humic materials introduced by freshwater flowoffs) of the surface sample is considered.


A description is presented of the theoretical effect of an inclined target on the measurements made by both steady-state (spectral) and time-resolved laser fluorosensors. The considered theory is used in conjunction with existing oceanographical information on waves to estimate the extent of the sea-state error and hence to predict the restrictions placed on fluorosensing by the sea-state. In theory the sea-state will effect the performance of laser fluorosensors. However, it is found that for spectral measurements the effect is negligible for the sea-states to be expected in deep water. For temporal measurements the instrument response is distorted, but if the full width at half maximum technique is used for deconvolution no significant extra error is introduced above those already associated with the technique.


The relative phase of a normally incident microwave signal scattered off the sea surface is a random function of space and time. The statistics of these random phase fluctuations contain information about the wave-height statistics. This study demonstrates that the wave-height spectra can be deduced directly in terms of the spectra of the phase fluctuations without recourse to inversion techniques even when surface roughness exceeds many wavelengths of the incident signal. In the particular case of a nadir-directed satellite-mounted microwave source operating in the backscatter mode, the wave-height and phase spatial spectra are proportional with a constant proportionality of $(2k_0)^2$ squared, where $k_0$ is the wavenumber of the scattered signal.


Papers are presented on buoy systems, microprocessors for ocean-related matters, undersea vehicles, floating industrial complexes, satellite (NOAA and Landsat) imagery data acquisition and processing, applications of underwater acoustics in the ocean, port operations, diving technology and operations, underwater optics, and university programs in marine studies. Consideration is also given to environmental effects on marine biota, automated measurement techniques, technical training of marine manpower, tanker operations, cables and connectors, component reliability, marine water quality, marine navigation and control systems, ocean thermal energy conversion, environmental aspects of offshore petroleum development, and safety aspects of ship operations.


Since the summer of 1971, the NOAA Data Buoy Office has deployed numerous environmental moored data buoys with automated data acquisition and over-the-horizon telemetry features. Initially the data link requirements were successfully met by judicious implementation of on-board HF communications and cooperative shore stations. This paper reviews the orderly transition of the data buoy system from HF to satellite communications. The various phases of satellite communications from testing to operational confidence and finally to full operational satellite mode are described. Analyses of data defining satellite communication performance in terms of link reliability and data quality are considered, and data acquisition and telemetry implementation are discussed with a view towards assisting potential satellite link subscribers in scoping out their system.
Descriptions are given of the major types of satellite oceanographic data available from the Satellite Data Services Branch of the Environmental Data Service's National Climatic Center, with the services available in each case noted. Consideration is given to: (1) scanning radiometer and very high resolution radiometer data from the polar-orbiting TOS/NOAA satellites, (2) VISSR GOES products, (3) Landsat products, (4) DMSP data, and (5) Skylab products. Other major types of data to be available in the near future from TIROS-N, Seasat-A, and Nimbus-G CZCS are also described. B.J.


SR and VHRR data from the NOAA polar-orbiting satellites and VISSR data from GOES are being used in a variety of ocean-oriented activities, including sea surface temperature mapping, sea ice monitoring, and detection of ocean currents and upwelling. New techniques of image and digital data processing, including time-lapse methods, have been developed recently. Landsat multispectral imagery has been used to demonstrate the feasibility of detecting ocean-scene color variations associated with such factors as water depth, sediment load, and chlorophyll concentration. The next Nimbus spacecraft is to carry the Coastal Zone Color Scanner, a sensor system developed specifically for these tasks. B.J.


Radar cross section data shows that the Gulf Stream has a higher cross section per unit area (interpreted here as a greater roughness) than the water on the continental shelf. A steep gradient in cross sections exists between the outer shelf and upper slope, injection of warm water onto the shelf, entrainment of water off the shelf, and increases in currents. This paper describes National Marine Fisheries Service program for monitoring these effects. The program has two parts: (1) the utilization of IR-radiometer imagery from NOAA satellites and weekly interpretation of this imagery in order to observe the location, movement, and size of meanders and eddies as they appear on the sea surface; and (2) since satellite imagery is limited to the sea surface, the observation of these Gulf Stream effects from aboard ship.


The United States Coast Guard performs a number of missions, including pollution surveillance, search and rescue, ice reconnaissance, and enforcement of laws and treaties, which require large scale ocean surveillance. This paper describes several airborne remote sensing systems used by the Coast Guard. Particular attention is given to AOSS II, a system which includes side-looking radar, IR/UV line scanner, aerial reconnaissance, and passive microwave imager, and the Aireye system which includes all the sensors of AOSS II except the passive microwave imager.


Simultaneous signatures of nearshore bottoms have been obtained using multispectral scanning sensors in a low altitude aircraft and in the Landsat 2 Satellite. The signatures were taken in nearshore environments ranging from an ocean front to the shallow waters of an enclosed bay. The water turbidity had absorption coefficients ranging from 0.15 to 1.60 and-scattering coefficients ranging from 0.07 to 0.87. Using points of known depth the signatures have been analyzed by means of a simple algorithm to establish depth at a large number of other points in the scene. Lines of these points have been compared to transects obtained by a precision acoustic fathometer. The low altitude aircraft results demonstrate potential capability for accurate mapping of nearshore bottoms where the bottom reflectances are reasonably consistent. The technique is also useful on multispectral signatures obtained from Landsat satellites although the areal resolution is less by a factor of approximately 700 and the mapping results are more subject to degradation by cloud cover. (Author)


A radiometer system having four channels, 5 GHz, 17 GHz, 34 GHz, all vertical polarization, and a 34-GHz sky horn, is described. The system, which is designed for collecting glaciological and oceanographic data, is intended for airborne use, and imaging is achieved by means of a multifrequency conically scanning antenna. Implementation of the noise-injection technique ensures the high absolute accuracy needed for oceanographic purposes. The collected data can be preprocessed in a microcomputer system and displayed in real time. Simultaneously, the data are recorded digitally on tape for more elaborate processing later, using ground facilities. In conjunction with a side-looking radar which is under development at present, the radiometers are intended as the remote-sensing basis for an all-weather ice reconnaissance service in the Greenland sea.

(Author)


A study is made of sea-surface temperature fronts by means of environmental satellites with particular attention to the winter cycle in the northeastern Gulf of Mexico. Climatic features of the Antarctic Polar Front Zone are considered along with front overlaysing of the continental slope in the eastern Bering Sea and scales of motion in the subtropical convergence zone. Fronts on the continental shelf are evaluated and tidal fronts on the shelf seas around the British Isles are examined. Papers are presented on wind effects on the surface to bottom fronts, a model of narrow jets in a zonal ocean, and asymmetric disturbances in the frontal zone of a Gulf Stream ring. Heat and mass transport processes in subsea permafrost are outlined and short-term variability in the bottom boundary layer of the deep ocean is reported. S.C.S.


Data from environmental satellites have been used to evaluate worldwide sea-surface temperature fronts. The VHR IR images from the NOAA polar-orbiting satellites are described with reference to the dates and location of data collection. The data are discussed in terms of the effects of noise in the infrared images, limitations to data collection due to seasonal variability, cloud cover, and atmospheric attenuation. Procedures for image enhancement and geometric corrections are outlined. Images are presented and discussed for a series of specific geographical locations. S.C.S.


During the winter of 1976-1977 a time series of NOAA satellite data was obtained which documented the seasonal cycle of sea surface temperatures. Data were obtained as both marine-enhanced images and computer compatible tapes. Fall cooling initially affected only the lakes and estuaries. A band of cold inner shelf waters then formed along the coast. This expanded seaward to the shelf break as the winter season progressed. At the extreme of winter cooling, two major thermal fronts remained: one near the shelf edge, separating the shelf from deep Gulf surface waters, and the other the cyclonic boundary of the Loop Current. The onset of spring warming was indicated by an increase in surface temperatures in the shallow inshore areas. The seasonal cycle was completed with the formation of nearly isothermal surface waters throughout the region, a condition characteristic of the summer season. (Author)


A simple prognostic model based on Ekman dynamics and available satellite sea surface temperature and wind data is used to estimate rates of frontogenesis and frontolysis in the central North Pacific in the winter of 1977. The computed patterns and rates are compared to those sensed by satellite, and reasonable agreement is found. In the subtropical region, frontogenetic and frontolytic bands tend to occur in pairs, an occurrence which is attributed to a wind stress maximum over the area. Typical observed frontogenetic rates are 0.5-1 deg C/100 km per week. The computed rates underestimate the observed ones. (Author)


Satellite infrared data show that the sea surface temperature pattern in the subtropical convergence consists of meridionally oriented alternating warm and cold plumes with a wavelength of about 200 km. In 1973, shipboard measurements during the Mid-Ocean Dynamics Experiment (MODE) revealed that the cold plumes resulted from southward advection of the surface water on the eastern flank of the Mode eddy and that the warm plumes were a result of northward advection on the western side. Along the edges of the plumes, small-scale frontogenesis was observed but was not resolved by the sampling scheme. Detailed measurements were made in March 1977 of the frontal structure at the southern end of a cold plume. These revealed the presence of smaller-scale motions with wavelengths of the order of 50 km. Temporal evolution of surface features in the vicinity and along the front occurred extremely rapidly and was barely resolved by surveys spaced 3-5 days apart. (Author)

A numerical model is used to derive the Simpson-Hunter stratification parameter on the shelf seas surrounding the British Isles. Positions of predicted fronts are compared with structures observed in infrared satellite images and the measurements of sea surface temperature recorded on a cruise around the British Isles. The numerical model predicts the stability of the frontal systems, and baroclinic instability is suggested as the main candidate for cross-frontal mixing. (Author)


From data obtained by the GEOS 3 radar altimeter, sea surface heights are found by both editing and filtering the raw sea surface height measurements and then referencing these processed data to a 5 foot by 5 foot geoid. Any trend between the processed data and the geoid is removed by subtracting out a linear fit to the residuals in a 5 foot by 5 foot geoid. The standard deviation map is even more informative and shows preferred locations of Gulf Stream meanders. (Author)
Robena J. Brown Jun. 1978 147 p Supersedes NTIS/PS-77/0533; NTIS/PS-76/0469; NTIS/PS-75/447 (NTIS/PS-75/0564/1); NTIS/PS-77/0533; NTIS/PS-76/0469; NTIS/PS-75/447) Avail: NTIS HC $28.00/MF $28.00 CSCL 08J
Remote sensing methods as they are applied to ocean currents, wind sediment transport, ocean waves, sea states, and air-water interactions are described. The various techniques of measurement using radiometers, lasers, radar, and microwave and infrared equipment are described.

GEOS-3 OCEAN CURRENT INVESTIGATION USING RADAR ALTIMETER PROFILING Final Report
Both quasi-stationary and dynamic departures from the marine geoid were successfully detected using altitude measurements from the GEOS-3 radar altimeter. The quasi-stationary departures are observed either as elevation changes in single pass profiles across the Gulf Stream or at the crowding of contour lines at the western and northern areas of topographic maps generated using altimeter data spanning one month or longer. Dynamic features such as current meandering and spawned eddies can be monitored by comparing monthly mean maps. Comparison of altimeter inferred eddies with IR detected thermal rings indicates agreement of the two techniques. Estimates of current velocity are made using derived slope estimates in conjunction with the geostrophic equation.

This publication contains the monthly issues, each having the following information: Gulf Stream position; selected bathythermograms; mean sea surface temperature; surface temperatures; monthly changes; and SST anomalies. The illustrations carry statements elaborating on the data.

Audrey S. Hundemann Aug. 1978 204 p Supersedes NTIS/PS-77/0719; NTIS/PS-76/0629; NTIS/PS-75/525 (NTIS/PS-78/0844/7; NTIS/PS-77/0719; NTIS/PS-76/0629; NTIS/PS-75/525) Avail: NTIS HC $28.00/MF $28.00 CSCL 08C
Abstracts dealing primarily with the Gulf Stream's currents, salinity, temperature and transport properties are presented. A few abstracts pertain to oceanographic equipment used in the studies. Remote sensing studies are included. This updated bibliography contains 197 abstracts, 35 of which are new entries to the previous edition.
Page intentionally left blank

Satellite imagery from the NOAA-4 and Landsat 1 and 2 satellites has been used to study the snow cover in the Saint John and Souris River basins. Images of visible and infrared data were analyzed by the optical-electrical method and an interpretation system incorporated image analyzer which evaluated shades of gray isopleths were drawn. Consideration was also given to mass of vegetative cover, relief, cloud cover, and weather reports in order to interpret the data.

A78-43317 # A study of snowmelt progression from Winnipe to the Arctic Islands using ERTS photographs. R. Hofer and G. Fuller (Regina University, Regina, Saskatchewan, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 143-148. Research supported by the National Research Council of Canada.

Photographs from the Earth Resources Technology Satellite (ERTS) have been applied to monitoring snowmelt progression in various regions of Canada. The regions represent a potential route for natural gas pipelines. On the basis of 155 ERTS photographs, four stages of snowmelt development are identified: the disappearance of the snow cover along ridges and southward facing valleys, the dark appearance of small lakes, the appearance of dark open river reaches, and the final disappearance of the snow cover. It is noted that the presence of cloud cover significantly influences the number of useful photographs available.


Landsat imagery has provided a regional representation of surface-soil moisture conditions in Canadian agricultural areas. The factors which influence the accuracy of the results are identified as: crop cover, surface dryness, and surface thaw. Comparisons have been made between images from different seasons. The study indicates a relationship between areas having soil samples with high clay content and the moisture bands of the Landsat imagery. Many fields within the moisture bands are noted to contain drainage tiles. It is concluded that if the imagery is monitored for suitable ground and weather conditions, the mapping of poorly-drained soils in agricultural regions may be effected using Landsat data.


Water distribution has been studied in Lac Saint-Jean, Quebec on the basis of multispectral digital data from Landsat-1 and Landsat-2. The methods of Langham and Taylor (1975), the images are enhanced in order to determine turbid zones. Grey levels are found for each multispectral band so as to increase the signal-to-noise ratio and the precision with which water reflectance is measured.

S.C.S.


It is shown that Landsat imagery may be used to evaluate lake characteristics including lake contents, water distribution, morphometric parameters, drainage, and local ground cover. Landsat imagery is also applicable to studying near-lake ecosystems and modifications occurring over extended periods of time.

S.C.S.


Chromaticity analyses of Landsat images are used for quantitative water-quality monitoring. Multispectral scanner radiances are normalized to eliminate brightness and enhance hue and saturation. Two modes of operation on the Image-100 analyzer are possible: point and area. Discrete loci are identified for bathymetry, chlorophyll, and suspended sediment. Atmospheric corrections are made for the effects of haze, air pollution, sunlight, and clouds. The results are displayed on a color television monitor and computer terminal. They may be output on a line printer or reproduced on hard copy.


The central delta of the Niger River, located in the Republic of Mali, is studied with the aid of Landsat imagery. Particular attention is given to the groundwater flow systems of the flood zone and the vegetation. Data from channels 4, 5, and 7 are used to assess the changes occurring in vegetation and flooded zones over extended time periods. Estimates are made of the free water surface area and the biomass in small-surface zones.

S.C.S.
The paper reports on the first results of an empirical technique which estimates convective rainfall using geosynchronous visible and infrared satellite imagery. The technique is based on brightness (reflected radiance) or temperature (emitted radiance) as parameters for identifying raining clouds, cloud area as a measure of the extent of the rain area, and stage of development as an indicator of rain intensity. To verify the derived relationships, satellite rain estimations are compared to rain-gage and/or radar data for two areas in south Florida, for an area in Venezuela, and for several hurricanes. It is shown that real-time application of the method through computerization has promise for pinpointing flash-flood situations, such as the Big Thompson flood. The accuracy of future results is expected to increase with the use of digital data.

S.D.


Landsat imagery from a 5-year time span has been used to study water circulation patterns on Croatan Sound and Pamlico Sound, North Carolina, as the patterns relate to erosion of the mainland shoreline. Evidence of probable attack by the sound waters on the shoreline has been correlated with a recent aerial photographic study of shoreline erosion. Approximately one-half of the Landsat images used in the study showed evidence of attack upon each of the several points studied. Landsat imagery, with its repetitive nature together with the accumulated images, provides a relatively inexpensive tool for rapid evaluation of potential for erosion along mainland shores of estuaries.

(Author)


The results obtained in the research program of microwave scattering properties of snow fields are presented. Experimental results are presented showing backscatter dependence on frequency (5.8-8.0 GHz), angle of incidence (0-60 degrees), snow wetness (time of day), and frequency modulation (0-500 MHz). Theoretical studies are being made of the inverse scattering problem yielding some preliminary results concerning the determination of the dielectric constant of the snow layer. The experimental results lead to the following conclusions: snow layering affects backscatter, layer response is significant up to 45 degrees of incidence, wetness modifies snow layer effects, frequency modulation masks the layer response, and for the proper choice of probing frequency and for nominal snow depths, it appears to be possible to measure the effective dielectric constant and the corresponding water content of a snow pack.

F.O.S.
RETRANSMISSION OF HYDROMETRIC DATA IN CANADA
Quarterly Report, Apr. - Jun. 1978
R. A. Halliday, Principal Investigator and I. A. Reid Jul. 1978
8 p Sponsored by NASA ERTS (E78-10174; NASA-CR-157269) Avail: NTIS HC A02/MF A01 CSCL 08H

The author has identified the following significant results. The project continued to demonstrate the feasibility of transmitting hydrometric data in the LANDSAT and GOES mode and using these data operationally. All elements except for the GOES downlink at PASS were functioning well.

N78-29532*# Texas A&M Univ., College Station. Remote Sensing Center.
MEASUREMENT OF SOIL MOISTURE TRENDS WITH AIRBORNE SCATTEROMETERS Progress Report, 1 Apr. 1977 - 1 Jun. 1978
Bruce J. Blanchard, Principal Investigator 1 Jun. 1978 110 p refs Sponsored by NASA ERTS (Grant NsG-1314) (E78-10176; NASA-CR-157271; RSC-3458-2) Avail: NTIS HC A06/MF A01 CSCL 08M

The author has identified the following significant results. Repeated looks at surfaces that maintain constant roughness can provide an estimate of soil moisture in the surface, when appropriate radar look angles are used. Significant influence due to differences in soil moisture can be detected in the 13.3 GHz and 1.6 GHz scatterometer returns. Effects of normal crop densities have little influence on the surface soil moisture estimate, when appropriate look angles are used. It appears that different look angles are optimum for different frequencies to avoid effects from vegetation. Considering the frequency and look angles used on the Seasat-A imaging radar, differences in soil moisture should produce as much as 9 db difference in return on that system.

N78-31484*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
GEOLOGICAL MAPPING OF REGIONAL DRAINAGE NETWORK IN BRAZIL USING LANDSAT IMAGES

N78-31487*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SURFACE HYDRODYNAMICAL MODELS THROUGH SYNOPTIC INTERPRETATION OF LANDSAT MSS IMAGES IN LAGOONAL AND COASTAL WATERS
Nelson deJesusParada, Principal Investigator and Renato Herz Apr. 1977 16 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 ERTS (E78-10188; NASA-CR-157378; INPE-1013-NTE/083) Avail: NTIS HC A02/MF A01 CSCL 08H

N78-31513# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
COMPUTER PROCESSING OF LANDSAT DIGITAL DATA AND SENSOR INTERFACE DEVELOPMENT FOR USE IN NEW ENGLAND RESERVOIR MANAGEMENT

06 HYDROLOGY AND WATER MANAGEMENT

Carolyn J. Merry and Harlan L. McKim Apr. 1978 68 p refs (AD-A055752; CRREL-SR-78-6) Avail: NTIS HC A04/MF A01 CSCL 08/6

A preliminary analysis of LANDSAT digital data using the NASA GISS computer algorithms for an 11 February scene of the upper St. John River Basin, Maine, showed that the total radiance of pixels contained in three snow courses varied from 5.34 to 7.74 mW/sq cm sr for a water equivalent of approximately 24.1 cm (9.5 in.) of water. This correlation between radiance values and water equivalent of the snowpack still needs to be tested. A multispectral signature was developed with an accuracy of 75% for a wetlands category in the Merrimack River estuary. Low-water reservoir and flood water stages were mapped from grayscale printouts of MSS band 7 for 27 October 1972 and 7 July 1973, respectively, for the Franklin Falls reservoir area, New Hampshire. Two snow pillow transducer systems for measuring the water equivalent of the snowpack in northern Maine were interfaced and field tested. Temperature data from the surface to a depth of 30 m (100 ft) were transmitted through the LANDSAT DCS. Also, a tensiometer/transducer system to measure moisture tension and soil volumetric moisture content was successfully interfaced to the LANDSAT DCS. GRA

APPLICATION OF HEAT-FLOW TEMPERATURE MODEL FOR REMOTELY ASSESSING NEAR SURFACE SOIL MOISTURE BY THERMOGRAPHY Final Report
Jerald A. Tunheim Nov. 1977 50 p refs (Contract DI-14-31-0001-6043) (PB-279615/7. W78-09352) Avail: NTIS HC A03/MF A01 CSCL 08H

Detection and mapping of near-surface ground water by the use of remote sensed thermal emittance data (thermography) are reported. The specific focus was on detection of saline seeps in their preemergence stages. Soil temperature profiles, water table depths, and other pertinent data were collected in two potential seep areas. These data were related to thermal emittance acquired during three aircraft flights and results were used to modify a theoretical model. Author

N78-32513*# Department of the Environment, Ottawa (Ontario).

The author has identified the following significant results. The LANDSAT program has demonstrated that polar orbiting satellites can be used to relay hydriologic data from any part of Canada to a user without difficulty and at low cost. These data can be used for many operational purposes, the most important of which were identified as follows: hydrielectric power plant operation: water supply for municipalities, industries, and irrigation; navigation: flood forecasting: operation of flood control structures and systems; and recreation.

N78-32514*# Environmental Research and Technology, Inc., Concord, Mass.
INVESTIGATION OF THE APPLICATION OF HCMM THERMAL DATA TO SNOW HYDROLOGY Progress Report, Jul. - Sep. 1978
James C. Barnes, Principal Investigator 28 Sep. 1978 5 p refs Sponsored by NASA ERTS (E78-10194; NASA-CR-157384) Avail: NTIS HC A02/MF A01 CSCL 08H

255
**06 HYDROLOGY AND WATER MANAGEMENT**

**N78-32516** 
National Oceanic and Atmospheric Administration, Washington, D. C.

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

Donald R. Wiesnet, Principal Investigator 15 Sep. 1978 3 p
Sponsored by NASA ERTS
(E78-10211: NASA-CR-157584: Rept-4) Avail: NTIS HC A02/MF A01 CSCL 08H

**N78-32528**
Ecosystems International, Inc., Gambrills, Md.

APPLICATIONS OF REMOTE SENSING TO HYDROLOGIC PLANNING Final Report

Harry Loats, Jr., Thomas Fowler, and Peter Castruccio Aug. 1978 148 p
(Contract NAS8-32423)
(NASA-CP-3041: M-258) Avail: NTIS HC A07/MF A01 CSCL 08H

The transfer of LANDSAT remote sensing technology from the research sector to user operational applications requires demonstration of the utility and accuracy of LANDSAT data in solving real problems. This report describes such a demonstration project in the area of water resources, specifically the estimation of non-point source pollutant loads. Non-point source pollutants were estimated from land cover data from LANDSAT images. Classification accuracies for three small watersheds were above 95%. Land cover was converted to pollutant loads for a fourth watershed through the use of coefficients relating significant pollutants to land use and storm runoff volume. These data were input into a simulator model which simulated runoff from average rainfall. The result was the estimation of monthly expected pollutant loads for the 17 subbasins comprising the Maryland watershed.

Author

**N78-33508**
World Meteorological Organization, Geneva (Switzerland).

A PLAN FOR THE COLLECTION AND TRANSMISSION OF HYDROMETEOROLOGICAL DATA IN THE BRASILIAN AMAZON BASIN

Robert A. Halliday, Principal Investigator Apr. 1978 97 p refs
Sponsored by NASA ERTS.
(E78-10175: NASA-CR-152720: BRA372/010) Avail: NTIS HC A05/MF A01 CSCL 08F

**N78-33511**
National Aeronautics and Space Administration.

RADAR TARGET REMOTELY SENSING HYDROLOGICAL PHENOMENA Patent Application

Wilford E. Sivertson, Jr., inventor (to NASA) Filed 22 Sep. 1978 18 p

Apparatus for remotely measuring and accessing water status at selected locations on the surface of the earth is disclosed. A radar target whose radar cross-section varies as a function of the height of the water level within the target is described. The target consists essentially of a right circular cylinder with its central axis perpendicular to the ground level, a flat circular plate symmetrically attached to the lower end of the cylinder and parallel to the ground level surface, and a catch basin including said circular cylinder and said circular plate for catching and retaining water. The circular cylinder and the flat circular plate are made from a material (electrical conductor) that reflects radar signals such as aluminum, copper, and stainless steel. The brightness of the image taken by a radar from a satellite or an airplane decreases as the level of the water increases. The level of water in a radar target is indicative of the water status at the location of that particular radar target.

NASA

**N78-33517**
Du Pont de Nemours (E. I.) and Co., Aiken, S. C.

NURE GEOCHEMICAL INVESTIGATIONS IN THE EASTERN UNITED STATES

(Contract EY-76-C-09-0001)
(DP-M5-77-101, Cont-780435-1) Avail: NTIS HC A03/MF A01

Stream samples were collected at a density of one per 13 square kilometers in crystalline rock areas and 25 square kilometers in sedimentary rock areas. Stream sediment was taken at each site, and stream water was concentrated on ion exchange resin in some areas. Ground water samples were collected at an average density of about one site per 20 square kilometers. Measurements made at each site included alkalinity, pH, and conductivity of water. Measurements of the radon and helium contents of ground water samples were made on a semiregional scale in pilot studies. Samples were analyzed by neutron activation techniques. Concentrations of uranium and about 20 other elements were determined in concentrated water samples. Results from several studies are discussed including a Triassic Basin area near Sanford, North Carolina; the North and South Carolina Coastal Plain; and from reconnaissance studies in the Carolinas-Virginia Piedmont and Blue Ridge areas. ERA

**N78-33523**

REMOTE SENSING APPLIED TO HYDROLOGY. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Jul. 1978

Audrey S. Hundemann Aug. 1978 196 p Supersedes NTIS/PS-77/0677
(NTIS/PS-78/0792/8: NTIS/PS-77/0677) Avail: NTIS HC $28.00/MF $28.00 CSCL 08H

The use of aerial and satellite imagery in hydrologic studies, including water resources planning and management, is discussed. The abstracts cover remote sensing studies of water quality, soil moisture, floodplain delineation, ice cover, and determination of snow depth and water equivalent. (This updated bibliography contains 189 abstracts, 33 of which are new entries to the previous edition.)

GRA

**N78-33618**
National Aeronautics and Space Administration.

LAngley Research Center, Hampton, Va.

LABORATORY AND FIELD MEASUREMENTS OF UPHOLED RADIANCE AND REFLECTANCE SPECTRA OF SUSPENDED JAMES RIVER SEDIMENTS NEAR HOPEWELL, VIRGINIA

(NASA-TP-1292: L-12298) Avail: NTIS HC A03/MF A01 CSCL 13B

Spectral reflectance characteristics of suspended Bermuda Hundred and Bailey Bay bottom sediments taken from the Hopewell, Va., area were measured in the laboratory for water mixture total suspended solids concentrations between 4 and 173 parts per million. Field spectral reflectance measurements were made of the James River waters near Bermuda Hundred on two occasions. The results of these tests indicate that both Bermuda Hundred and Bailey Bay suspended sediments produce their strongest reflectance in the green and red regions of the spectrum.

Author
DATA PROCESSING AND DISTRIBUTION SYSTEMS

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

A78-43207 # Biophysical mapping in northwestern Ontario from aircraft and satellite remote sensing data. N. J. Kozlovic and P. J. Howarth (McMaster University, Hamilton, Ontario, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 27-36. 16 refs. Research supported by the National Research Council of Canada and McMaster University.

A78-43223 # Interpretation and planning of thermal IR imagery. J. Veck (Toronto, University, Toronto, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 200-207. 6 refs. Various heat-transfer models used in the interpretation of thermal infrared imagery are discussed. An energy balance equation at the terrain surface, in terms of the net radiation flux representing the difference between incident solar flux and the reflected and emitted radiation components, is presented. Heat transfer at the atmospheric boundary layer is noted to be a function of wind profile, temperature gradients, and the three-dimensional surface configuration. Two sources of thermal radiation detected by the sensor are identified: the radiant power emitted by the surface, and the reflection of the atmosphere by surface features which are not perfect absorbers. Sample thermal images are presented for a bare field in the spring, a winter wheat field, a surface-drainage channel scar, a newly cultivated field, and forestland.

A78-43326 # The Canada Centre for Remote Sensing's image analysis system (CIAS). G. D. Goodenough (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 227-244. 19 refs. Attention is given to the image analysis system developed by the Canada Centre for Remote Sensing. The system consists of a modified image 100 device and a PDS color microdensitometer. The system makes it possible to classify a full Landsat frame into 93 distinct classes with maximum likelihood discrimination. The entire process takes less than 14 minutes. Three parallel data paths are provided: the UNIBUS, the RH70/DWR70 bus, and the IAP-supported path. Images are stored in 44-megaword disks. A graphics tablet is employed for limited map-information digitization, map-information selection, the selection of test sites, and map overlay. Output consists of single-class plots matching map scales from 1:50,000 to 1:1,000,000 color photographs.

A78-4329 # Computer processing of Landsat data as a means of mapping land use for the Canada land inventory. J. S. Schubert (Gregory Geoscience, Ltd., Ottawa, Canada), J. Thie, and D. Glisan (Environment Canada, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 268-281. 14 refs. Techniques for computer processing Landsat data for land-use mapping in Canada are described. Visual classification is performed using a television display of computer-enhanced remotely sensed data. The visual classification is then simulated in color infrared imagery and Taylor's enhancement technique. Computer classification consists of both supervised and nonsupervised interactive methods and the Land-Analysis automatic classification technique developed for the classification of vegetation.


With reference to related studies, the article discusses the processing of digital thematic maps from classified Landsat imagery such that after processing, the map regions have areas less than a preset minimum. The technique is based on an algorithm developed by Davis and Peet (1976) which finds all regions having areas less than a determined minimum and converts them to their most likely neighbor.


Techniques for automatic cartography on the basis of computer-processed remotely sensed data are outlined. Several correction and classification programs are described, including the FRACORCA, FRALISSE, FRACARTO, and FRACAM programs. Applications to studies of mud-flat geomorphology and marine turbidity are noted.

A78-43351 # Recognition and modification of areas less than a minimum. W. A. Davis (Alberta, University, Edmonton, Canada) and F. G. Peet (Canadian Forestry Service, Forest Management Institute, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 282-293. 8 refs.


Techniques for automatic cartography on the basis of computer-processed remotely sensed data are outlined. Several correction and classification programs are described, including the FRACORCA, FRALISSE, FRACARTO, and FRACAM programs. Applications to studies of mud-flat geomorphology and marine turbidity are noted.

A78-43353 # Computerized generation of control points on LandSat imagery (Génération automatisée de points de contrôle sur les images Landsat). A. Scott (CDG System, Ottawa, Canada) and G. Rochon (Universite Laval, Quebec, Canada). In: Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1977, p. 565-572. In French.
A new procedure for generating control points on Landsat imagery with a view to subsequent geometric correction has been designed and tested. The procedure is based on locating by computer the mass centres of the lakes appearing on the Landsat images. The lakes which are located and identified and whose morphometric characteristics remain largely unchanged from one image to the next are retained as control points. An affine transformation using these control points and applied to an image of 500 pixels per side gave a residual error of less than 0.8 RMS pixels.

Some difficulties were encountered with the telephone lines. It is suggested that the original computer-produced maps taken to the field contain more classes than are expected to be mapped because in the field it is easier to group classes than to reclassify or separate classes when only the remote terminal is available for display.

---


Methods used to correct Landsat data for atmospheric variability are discussed. Attention is given to the Multiplicative and Additive Scene Correction (MASC) algorithm (Henderson, 1975) which assumes that certain types of ground cover have stable spectrally reflectances. Atmospheric corrections utilizing oligotrophic lakes as standard reflectors (Ahern, et al., 1977) are described. The methods are evaluated for ground and aircraft measurements made with Landsat passes over Canadian lake regions. It is found that when using oligotrophic lakes as standard reflectance targets, atmospheric variability is removed to within plus or minus one grey level on a 128-grey-level scale.

---


A method for using cloud shadows to order to correct satellite images for the effects of backscattered solar radiation is proposed. The technique is evaluated for an area south of Lake St. Clair near Detroit. A similar method for using cloud shadows for image corrections (Piech and Schott, 1974) is noted.

---

**A78-43619** Application of space-borne photography to mapping and investigation of earth resources (Ob ispol'zovani materialov kosmicheskikh s'emok pri kartografirovani i izuchenii prirodnnykh resursov), Iu. P. Kienko, L. I. Zlobin, V. I. Bumbis, Iu. G. Kel'ner, V. V. Kiselev, V. V. Kozlov, and M. E. Solomatkin. Geodezija i Kartografiia, Apr. 1978, p. 20-29. In Russian.

In the present paper, potential uses of remote sensing are examined, with particular reference to the study of earth resources and the preparation of respective maps. The principles and possibilities of satellite photography are discussed, along with photogrammetric processing and digitizing.

---


Small-scale, land-classification maps digitally produced from Landsat data have been field checked using a remote portable teletypewriter linked to the Interactive Digital Image Manipulation System. The terminal provided image classification, statistical manipulation, class grouping, and map printout in alphanumeric form.

The process is observed to make field checking faster, to provide statistical data integration, and to reduce the required time and costs.

---


The linear least squares method of transformation of coordinates from Landsat MSS to map systems and vice versa is described and illustrated, with reference to Landsat and map geometry. It is shown that, for a whole Landsat scene, map points can be matched with a standard deviation of about plus or minus 200 metres, while for small areas this figure can be improved to about plus or minus 50 metres. It is shown that eight to ten pairs of homologous points are sufficient to achieve this accuracy and that little or no improvement is achieved by using more. The implications for mapping scales are discussed.

---


A small digital processing system has been applied to NOAA images. Image enhancement of these images improves contrast. An interpolation method was used to study the conversion of the NOAA data to a mapping system such as Mercator or polar stereo. A grey level histogram technique is used to extract the sea area from the IR image, and the temperature distribution of the sea surface is displayed. Interpolation of picture elements is discussed, and image magnification with boundary smoothing is considered.

---


Certain aspects of image processing in remote sensing are reviewed with reference to extraction of information on earth resources from Landsat and aircraft pictures. Attention is given to agricultural land use using supervised and unsupervised classification, and to the study of forest cover. Digital processing techniques are applied to photogeology, and water turbidity and quality studies. Analog processing is also discussed.

---

**A78-47083** Standard Mesh compatible Landsat mapping. S. Tanaka, H. Kano (Remote Sensing Technology Center of Japan, Tokyo, Japan), and Y. Suga (Hosei University, Koganei, Tokyo, Japan). In: International Symposium on Space Technology and Science, 12th, Tokyo, Japan, May 16-20, 1977, Proceedings. Chofu, Tokyo, National Aerospace Laboratory, 1977, p. 605-610.

A procedure is described for rendering Landsat MSS data for Japan compatible with the Standard Area Mesh established by the Japanese Statistics Bureau. The basic features of this Standard Mesh-compatible Landsat map are that (1) the pixel feature is almost square, (2) the pixel number corresponding to the Mesh is the same in every image, and (3) the radiometric value of MSS data is sufficiently preserved.

Two Landsat MSS images of four areas in Japan - a farming area, a city, a mountain area, and a bay - are examined in an effort to compare radiance values. The radiance value of Band 4 (0.5-0.6 micron) taken in October 1972 is greater than that of Band 4 taken in September 1975 for all the areas, while the reverse is true for Band 6 (0.7-0.8 micron). The differences in radiance are apparently due to the effects of weather and vegetation. Using the same images, four different methods of ground control point matching are tested. Landsat data is then applied to the detection of red tide off Japan.

B.J.


The effect of increased contrast of Landsat imagery is to stretch the informational content over a much greater density range. This results in greater density differences among scene features and provides a more interpretable image. The stretch required for MSS 5 and 7 is in the gamma range of 1.5 to 3.0. Several different film types, developers, and development times were used to reprocess Landsat images in a range of gammas from 1.0 to above 4.0. The gamma value to which the imagery was processed depended on the informational content over a much greater density range. This provides a more interpretable image. An example of a photographically enhanced MSS 4 image is shown, in which the standard 0.94 density units was increased to 2.19 density units. The results are similar to those obtained in a computerized contrast stretch of digital CCT data, but are obtained at a far lesser cost.

P.T.H.


Through use of manual spot densitometry values derived from multitemporal 1:24,000 color infrared aircraft photography, areas as small as one hectare in the Cumberland Plateau in Kentucky were accurately classified into one of eight ground cover groups. If distinguishing between undisturbed and disturbed forest areas is the sole criterion of interest, classification results are highly accurate if based on imagery taken during foliated ground cover conditions. Multiseasonal imagery analysis was superior to single data analysis, and transparencies from prefoliated conditions gave better separation of conifers and hardwoods than did those from foliated conditions.

P.T.H.


Photography, films, and filters are considered along with questions related to orientation and study of aerial photographs, photoscale and stereoscopic parallax, stereogram, shadow heights, flight planning, planimetric and topographic mapping, nonphotographic imaging systems, land information systems and land-cover mapping, prehistoric and historic archeology, agriculture and soils, forestry applications, landforms and physiographic features, engineering applications and mining patterns, urban-industrial patterns, and air intelligence and military target analysis. Attention is given to remote sensing and interpretation, relative apertures, camera viewing angles, photographic film, developing and printing, resolution and spectral sensitivity, infrared color or camouflage-detection film, the development of photogrammetry, principles of object recognition, three-dimensional photography, the precision of height determinations, topographic maps from paper prints, the nature of infrared radiation, radar image interpretation, the significance of land use patterns, site evaluations, land and crop classifications, water erosion, the classification of vegetation, applications of photogeology, and nonphotographic imagery.

G.R.


A critique of traditional classification techniques for Landsat images and consideration of some scene analysis techniques, exploiting spatial organization and meaning, lead to a new approach to computer programs for Landsat image understanding. To justify this approach, a program that combines modified maximum likelihood techniques with interpretation-controlled region merging methods to interpret forest cover in Landsat images is described. For comparison purposes, a pure supervised classifier using the same data made 43% more errors and produced a segmentation twice as complex. (Author)


The described method for the photographic enhancement of linear features involves the use of overlaid positive and negative transparencies maintained in perfect registration to eliminate the bias due to offsetting. By placing the transparencies so that the emulsion is up on the top film and down on the bottom film, almost all light in the normal direction is blocked, so that only a small amount of light will pass through by means of oblique illumination and reach the unexposed negative film placed below the positive and negative pair. Since light will pass through only at the boundaries of light and dark areas, linear features are enhanced for both man-made and geologic features on satellite-acquired images.

M.L.
TECHNIQUE FOR DYNAMIC RANGE REDUCTION FOR Vitor Celso CelsodeCarvalho Apr. 1978 40 p refs In as well as geneial purpose computers. This technique also has a model of the multispectral image, is presented. It can be implemented on stand-alone digital image processing systems as well as general purpose computers. This technique also has potential application in machine classification of geological data. Digital image processing examples are presented in which this new scheme is compared with other commonly used techniques for dynamic range reduction.


The World Standard Catalog lists imagery acquired by LANDSAT 2 which has been processed and input to the data files during the referenced months. Data, such as cloud cover and image quality, are given for each scene. The microfilm roll and frame on which the scene may be found is also given. Author

INTRODUCTION TO A MULTISPECTRAL DATA ANALYSIS SYSTEM [APRESENTACAO DE UMA SISTEMATICA PARA A ANALISE DE DADOS MULTIESPECTRAIS] Vitor Celso CelsodeCarvalho Apr. 1978 40 p refs in PORTUGUESE (INPE-1227-NTE/115) Avail: NTIS HC A03/MF A01 CSCL 08H

A system that automatically translates multispectral data obtained by remote sensing is described. Basic concepts were examined briefly, and examples of application in various areas of natural resources were reviewed. Transl. by B.B.


A scheme for dynamic range reduction, based on a mathematical model of the multispectral image, is presented. It can be implemented on stand-alone digital image processing systems as well as general purpose computers. This technique also has potential application in machine classification of geological data. Digital image processing examples are presented in which this new scheme is compared with other commonly used techniques for dynamic range reduction.


Several hypotheses concerning LANDSAT data are analyzed. These hypotheses are: (1) LANDSAT does not discriminate between vegetation types, but mostly sees chlorophyl and canopy cover. (2) A majority of the features in the ground scene possess linearity proportional amounts of color from each spectral band. (3) The data are continuous and as a result there is no true separability...
of ground scene features in the data, but some features possess an excess of color in a particular band pair. (4) There are relatively few features present in the spectral data, and these do not correspond to the conventional definitions that are used. (5) Aside from seasonal effects, in a distributional sense all LANDSAT data are essentially the same. The only difference is the way the data are spatially arranged in the image. S.B.S.

APPLICATION OF MULTISPECTRAL RADAR AND LANDSAT IMAGERY TO GEOLOGIC MAPPING IN DEATH VALLEY
Side-Looking Airborne Radar (SLAR) images, acquired by JPL and Strategic Air Command Systems, and visible and near-infrared LANDSAT imagery were applied to studies of the Quaternary alluvial and evaporite deposits in Death Valley, California. Unprocessed radar imagery revealed considerable variation in microwave backscatter, generally correlated with surface roughness. For Death Valley, LANDSAT imagery is of limited value in discriminating the Quaternary units except for alluvial units distinguishable by presence or absence of desert varnish or evaporite units whose extremely rough surfaces are strongly shadowed. In contrast, radar returns are most strongly dependent on surface roughness, a property more strongly correlated with surficial geology than is surface chemistry.

Author

N78-30640# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Electrical and Systems Engineering.
SOME NEW MAP DATA ENCODING SCHEMES Interim Report Herbert Freeman 1978 11 p refs (Grant AF-AFOSR-2937-76) (AD-A054853; AFOSR-78-0946TR) Avail: NTIS HC A02/ MF A01 CSCL 09/4
Some new schemes for encoding map data are introduced. The schemes can be regarded as generalizations of the well known 8-direction chain coding scheme. Instead of being limited to 8 types of links for approximating a curve, the new schemes possess 16, 24, 32, 48, or even more link types. The new schemes permit increased smoothness of representation; exhibit greater precision, and require less processing time for comparable resolution than present methods. Author (GRA)

N78-30876# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DETECTION OF IMAGE BOUNDARIES: MATHEMATICAL FORMULAS [DETECCAO DE BORDAS EM IMAGENS: FORMULACAO ESTATISTICA]
A digital image store, based on CCD technology designed for an image processing system is described. The processing system, termed IDP 3000, was introduced to fulfill a requirement in the field of Earth Resource Surveying and the design of the store reflects the requirements of the specific area application. The requirements were introduced and the specific solution adopted is described. Particular attention is paid to the relationship with a standard 625 line TV signal. Each function available in the store is discussed and the method of implementation is summarized. An indication of the reliability of the store was given as well as a description of its application to simulator development. B.B.

N78-31479# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
INPE LANDSAT SYSTEM

N78-31480# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STUDY OF GEOMETRIC DISTORTIONS OF LANDSAT IMAGES
The capabilities of the NASA Ames Center U-2 aircraft for research or experimental programs are described for such areas as Earth resources inventories; remote sensing data interpretation, electronic sensor research and development; satellite investigative support; stratigraphic gas studies; and astronomy and astrophysics. The availability of this aircraft on a cost-reimbursable basis for use in high-altitude investigations that cannot be performed by the private sector is discussed. A.R.H.

N78-31508# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
HIGH ALTITUDE PERSPECTIVE 1978 33 p Original contains color illustrations (NASA-SP-427) Avail: NTIS MF A01; SOD HC $1.60 CSCL 14E
The capabilities of the NASA Ames Center U-2 aircraft for research or experimental programs are described for such areas as Earth resources inventories; remote sensing data interpretation, electronic sensor research and development; satellite investigative support; stratigraphic gas studies; and astronomy and astrophysics. The availability of this aircraft on a cost-reimbursable basis for use in high-altitude investigations that cannot be performed by the private sector is discussed. A.R.H.

N78-31516# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
THE COVERAGE FIELD OF EARTH OBSERVATION SATELLITES AT THE EARTH SURFACE. DESCRIPTION OF THE COMPUTER PROGRAM COFI [DAS UEBERDECFLUKSfeld ERDBEObachtender Satelliten AUF DER ERDOBERFLAECHE. BESCHREIBUNG DES RECHNERPROGRAMS COFI]
DATA PROCESSING AND DISTRIBUTION SYSTEMS

E. Fritz Jochim and W. Pawlik 1977 66 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-487) (DLR-IB-552-77/40) Avail: NTIS HC A04/MF A01

A FORTRAN 4 a computer program which generates a geographical coordinates or latitude-mean solar time printer plot of coverage field and coverage frequency of an earth observation satellite is described. Any nadir angle and half width of the perpendicular to the trajectory scanning sensor may be selected. Repeatedly covered regions are characterized by different output characters. The presentation may be limited on certain local solar time intervals.

Author (ESA)

M78-32628#/ Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

SHADeD PERSPectIVe IMaGe oF TERRAIN
Thomas M. Strat Mar. 1978 39 p refs
(Contract N00014-75-C-0643) (AD-A055070: AI-M-463) Avail: NTIS HC A03/MF A01 CSCL 08/2

In order to perform image analysis, one must have a thorough understanding of how images are formed. This memo presents an algorithm that produces shaded perspective images of terrain as a vehicle to understanding the fundamentals of image formation. The image is constructed using standard projection equations along with an efficient hidden-surface removal technique. The image intensity is calculated using the reflectance map, a convenient way of describing the surface reflection as a function of surface gradient. Aside from its use as a tool toward understanding image analysis, the algorithm has several applications of its own, including providing video input to a flight simulator.

Author (GRA)

N78-32634# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LAnDsat 2 World StanDaNd CaTaLoG. 1 MaY - 31 JULy 1978
31 Jul. 1978 322 p
(NASA-TM-79935; GSFC/LWC2-78/07; NTISUB/D/276-007) Avail: NTIS HC A14/MF A01 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The Non-U.S. Standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles.

Author

N78-32638# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LAnDsat 3 World StanDaNd CaTaLoG. 6 MArCh - 31 JULy 1978
Jul. 1978 521 p
(NASA-TM-79902; GSFC/LWC3-78/07; NTISUB/D/227-007) Avail: NTIS HC A23/MF A01 CSCL 05B

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

A.R.H.
INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

A78-43327


The article surveys French remote sensing projects. Devices including visible and infrared cameras and multispectral scanners, thermal infrared scanners, and microwave multifrequency radar are described. Methods for data processing and interpretation are presented noting multipath number techniques, interactive digital viewing systems, and digital-data printing systems. Target projects are discussed with reference to resource and water monitoring, vegetation and forestland mapping, and pollution studies. Projects incorporating side-looking airborne radar, thermal detectors, and Landsat data are reviewed. S.C.S.

A78-43338


The operation and interpretation of X-ray side-looking airborne radar (SLAR) are discussed with reference to both real aperture and synthetic aperture configurations. Operational parameters associated with the aircraft flight and the radar equipment are reviewed. Limits to SLAR performance are identified, including range display, swath width, scale, and resolution. The terrain features which influence radar return are considered, noting the conductivity and dielectric constant of the ground, surface geometry, local surface roughness, relief, and slope. Procedures for SLAR imagery interpretation, considering tone, speckle, texture, size, shape, shadow, and association, are outlined. S.C.S.

A78-43344


Canadian environmental and resource management using synthetic aperture radar (SAR) systems is outlined. The program is designed to identify cost-effective potential applications for radar remote sensing. The ERIM X-L SAR system, consisting of imaging sensors transmitting in the X- and L-bands, is described. Attention is given to hybrid optical-digital signal processing. This procedure consists of an optical processor interfaced to an image dissector, a computer program providing digitization, and recording and display apparatus. S.C.S.

A78-43637


Remote sensing data in the optical, infrared, and microwave range have become indispensable for a number of scientific investigations. The importance of the microwave sensor has increased in recent years in connection with its all-weather capability, which is vital for the geographical latitudes of Central Europe. Current limitations regarding the use of the microwave sensor are related to technological problems. In connection with the clearly recognized needs for a suitable microwave sensor, West Germany wants to improve the technology related to the microwave remote sensing of the earth. It is planned to provide for the users an operational satellite sensor system during the mid-1980s. A program for implementing this objective is being prepared. The first step taken in this connection was the design of a cost-efficient experimental radar device for the observation of the earth from an aircraft. Basic information regarding the observation of the earth with radar is considered and a survey is provided regarding the performance of the new device, taking into account the first results. G.R.

A78-43640


It is intended to employ two remote sensing systems built in West Germany during the first Spacelab mission. The systems include a photogrammetric camera and a microwave remote sensing instrument. The microwave instrument can be used as a two-frequency scatterometer for sea-state measurements, as a radiometer providing brightness temperatures, or as an imaging synthetic aperture radar system. The basis for the Spacelab program is an agreement between NASA and the European Space Agency. The remote sensing experiments of the first Spacelab mission can be considered as preliminary stages concerning the development of a European satellite for remote-sensing applications. The sensors employed during the first Spacelab mission are subsequently to be modified for additional experiments which are to be conducted during a later Spacelab mission. G.R.

A78-44828


Equipment and techniques for the calibration of aerial survey cameras have been developed progressively at the National Research Council of Canada with the goals of providing a high level of real accuracy, versatility to accommodate a variety of camera, filters, and emulsions, and an economy of operation which permits recalibration at yearly intervals. Present apparatus and methods are described, and reasons for their construction and choice are explained. Results of three calibrations, made at different times, of two test cameras are given. They illustrate the degree to which cameras change with time and use. (Author)

A78-45023


Airborne microwave measurements with a nadir-viewing X band radiometer operating at a wavelength of 2.65 cm are described. The measurements over adjacent bare and vegetated surfaces are compared with ground truth samples of soil moisture content (SMC). For the bare surface the emissivity is highly correlated (r = 0.97) with the SMC of the top 0.5 cm, with an antenna temperature dependence

263
Backus-Gilbert methodology is made to obtain an objective criterion of the best resolution (in a least squares sense) obtainable from a given system and to investigate the trade-off between resolution and noise in the derived average brightness temperatures. The mathematically related problem of simultaneously analyzing antenna temperature measurements made at different frequencies by antennas with noncoincident antenna patterns is also considered. (Author)


The paper is a survey of theoretical and experimental studies of the microwave radiometry of soil moisture. Consideration is given to the physics of moisture-radiation relationships, the radiation properties of nonuniformly moist soils, and the screening effect of vegetation.

B.J.

N78-28576* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing. 


The author has identified the following significant results. The probability of correct classification of various populations in data was defined as the primary performance index. The multispectral data being of multiclass nature as well, required a Bayes error estimation procedure that was dependent on a set of class statistics alone. The classification error was expressed in terms of an N dimensional integral, where N was the dimensionality of the feature space. The multispectral scanner spatial model was represented by a linear shift, invariant multiple, point system where the N spectral bands comprised the input processes. The scanner characteristic function, the relationship governing the transformation of the input spatial and hence, spectral correlation matrices through the systems, was developed.


This report describes a program for the development, brassboard fabrication and testing of an airborne Solid State CCD Data Processor that demonstrates a method of transmitting a standard TV signal over a narrow bandwidth link by processing the TV signal, using CCD-488 devices in an 'analogue storage mode': The Data Processor brassboard shown in Figure 1, is designed to electrically interface with the Systems Research Laboratory's (SRL) TV Camera, 326-H2 and the Fairchild CCD-488 TV Camera (MV301) and to mechanically interface with the Aquila airframe.
and prediction of severe storms. The geosynchronous orbit allows the continuous atmospheric measurement needed to resolve mesoscale dynamics. The instrument may operate in conjunction with this document, Volume 1 - Management, which summarizes the highlights of final reports on both the radiometer instrument and antenna studies. The radiometer instrument summary includes a synopsis of Volume 2 - Radiometer Receiver Feasibility, including design, recommended configuration, performance estimates, and weight and power estimates. The summary of the antenna study includes a synopsis of Volume 3 - Antenna Feasibility, including preliminary design tradeoffs, performance of selected design, and details of the mechanical/thermal design.

---

**THE TIROS-N POLAR ORBITING-ENVIRONMENTAL SATELLITE SYSTEM**


The TIROS operational satellite (ITOS), launched in its current configuration with radiometers as NOAA-2 in October 1972, is the present type of NOAA polar orbiting operational satellite. Satellite and ground system capabilities of interest to the users of direct readout services from the system were examined in detail.

---

**ADVANCED MULTISPECTRAL SCANNER (AMS) STUDY Final Report**


The status of aircraft multispectral scanner technology was accessed in order to develop preliminary design specifications for an advanced instrument to be used for remote sensing data collection by aircraft in the 1980 time frame. The system designed provides a no-moving parts multispectral scanning capability through the exploitation of linear array charge coupled device technology and advanced electronic signal processing techniques. Major advantages include: 10.1 V/H rate capability: 120 deg FOV at V/H = 0.25 rad/sec: 1 to 2 rad resolution; high sensitivity; large dynamic range capability; geometric fidelity; roll compensation; modularity; long life; and 24 channel data acquisition capability. The field flattening techniques of the optical design allow wide field view to be achieved at fast f/nos for both the long and short wavelength regions. The digital signal averaging technique permits maximization of signal to noise performance over the entire V/H rate range. A.R.H.

---

**A SPECTRAL METHOD FOR DETERMINING THE PERCENTAGE OF LIVE HERBAGE MATERIAL IN CLIPPED SAMPLES**

Compton J. Tucker Nov. 1977 24 p refs Submitted for publication (NASA-TM-78019) Avail: NTIS HC A02/MF A01 CSCL 20F

A laboratory spectroradiometric method for the rapid determination of live/dead vegetation percentages from clipped grass samples has been developed and preliminarily tested. The method utilizes the red and photographic infrared reflectance or radiance differences between green vegetation and that of dead vegetation. Mixtures of green and dead material were found to have reflectances or radiances proportional to the percentage of green material present. This method offers the possibility that rapid live/dead spectroradiometric determinations may replace the tedious hand-sorting now generally in use for many situations. Author

---

**THE SKYLAB S191 SPECTROMETER EXPERIMENT: ANALYSIS OF DATA AND THEIR APPLICATIONS TO THE EARTH SCIENCES**


For abstract, see N78-30748.

---

**AN EVALUATION OF THE FIRST FOUR LANDSAT-D THEMATIC MAPPER REFLECTIVE SENSORS FOR MONITORING VEGETATION: A COMPARISON WITH OTHER SATELLITE SENSOR SYSTEMS**


The first four LANDSAT-D thematic mapper sensors were evaluated and compared to: the return beam vidicon (RBV) and multispectral scanners (MSS) sensors from LANDSATS 1, 2, and 3; Colvocoresses' proposed 'operational LANDSAT' three band system; and the French SPOT three band system using simulation/integration techniques and in situ collected spectral reflectance data. Sensors were evaluated by their ability to discriminate vegetation biomass, chlorophyll concentration, and leaf water content. The thematic mapper and SPOT bands were found to be superior in a spectral resolution context to the other three sensor systems for vegetational applications. Significant improvements are expected for most vegetational analyses from LANDSAT-D thematic mapper and SPOT imagery over MSS and RBV imagery. Author
A lecture is presented and attempts to enumerate how, in man-made remote sensing systems, the data are acquired, how they are modified and, above all, how they can be organized, analyzed and interpreted to provide new information. Of particular value and interest to the engineer, planner and resource manager are remote sensing systems that supply information about the terrestrial environment from aerial or space vantage point. The following topics are discussed: (1) fundamentals of remote sensing; (2) idealized remote sensing systems; (3) energy sources; (4) target interactions; (5) atmospheric effects; (6) practical remote sensing systems - multi-band photographic system, radiometers, scanners, side-looking airborne radar, passive microwave systems; and (7) data processing.

**N78-32937**

National Aeronautics and Space Administration.

Langley Research Center, Hampton, Va.

MAGNETOMETER WITH A MINIATURE TRANSDUCER AND AUTOMATIC SCANNING Patent


The magnetometer is based on the time variation of the magnetic permeability in the magnetic material of its transducer; hence, its operation is substantially different from the ordinary flux-gate magnetometer. The transducer uses 0.05 mm diameter plated magnetic wire and is made flat enabling it to make measurements of transverse magnetic fields as close as 0.08 mm from the surface, and it has very good spatial resolution because of its small active region of approximately 0.64 mm by 0.76 mm. The magnetometer uses an inexpensive clip-on millimeter for driving and processing the electrical signals and readout. It also utilizes an automatic scanning technique which is made possible by a specially designed transducer holding mechanism that replaces the ink pen on an X-Y recorder.

Official Gazette of the U.S. Patent Office

**N78-32398**

National Aeronautics and Space Administration.

Langley Research Center, Hampton, Va.

VISIBLE AND INFRARED POLARIZATION RATIO SPECTRO-REFLECTOMETER Patent Application

Carmen E. Batten, inventor (to NASA) Filed 28 Jul. 1978 19 p


The invention relates to an instrument for determining the optical constants of a sample material by causing light of various angles of polarization to impinge upon the sample at various angles of incidence and measuring the reflectivity of the reflected light at various wavelength. The ratio of the intensity of the reflected light for parallel polarized light to that for perpendicular polarized light at two different angles of incidence can be used to determine the optical constants of the sample. The novel feature of the invention appears to reside in a spectroreflectometer employing coordinated rotating platforms which enable the automatic alignment of the instrument at a wide variety of angles of incidence.

**N78-33502**

Virginia Univ., Charlottesville.

DETECTION AND LOCATION OF RESEAXUS USING PICTORIAL PATTERN RECOGNITION Ph.D. Thesis

James Hiram Aylor Jr. 1977 133 p

Avail: Univ. Microfilms Order No. 7812135

An automatic system to locate plus-like images called reseaux on aerial photographs is presented. A minicomputer system and microdensitometer is used for accurate location of these images within a photograph. A model was generated from the statistics of actual reseaux samples to create a test vehicle for the performance of various picture processing algorithms. A method of including various photographic effects into the model is presented. Various combinations of scene analysis schemes are presented with results for the center location problem. Postprocessing techniques for noise removal are described. Also developed is a scheme for noise removal. Two methods of center location are described and comparative speed and accuracy results are presented. The operation of the final system is also described.

Dissert. Abstr.

**N78-33512**

National Aeronautics and Space Administration.

Goddard Space Flight Center, Greenbelt, Md.

REMOTE SENSING OF ATMOSPHERIC WATER VAPOR, LIQUID WATER AND WIND SPEED AT THE OCEAN SURFACE BY PASSIVE MICROWAVE TECHNIQUES FROM THE NIMBUS-5 SATELLITE


The microwave brightness temperature measurements for Nimbus-5 electrically scanned microwave radiometer and Nimbus-E microwave spectrometer are used to retrieve the atmospheric water vapor, liquid water and wind speed by a quasi-statistical retrieval technique. It is shown that the brightness temperature can be utilized to yield these parameters under various weather conditions. Observations at 19.35 GHz, 22.35 GHz and 31.4 GHz were input to the regression equations. The retrieved values of these parameters for portions of two Nimbus-5 orbits are presented. Then comparison between the retrieved parameters and the available observations on the total water vapor content and the surface wind speed are made. The estimated errors for retrieval are approximately 0.15 g/sq cm for water vapor content, 6.5 mg/sq cm for liquid water content and 6.6 m/sec for surface wind speed.

Author

**N78-33513**

Systems and Applied Sciences Corp., Riverdale, Md.

REMOTE SENSING OF RAIN OVER THE OCEAN Final Report

8 May 1978 36 p refs

(Contract NAS5-24198)

(NASA-CR-156843; R-SAG-5/78-01) Avail: NTIS HC A03/MF A01 CSCL 04B

Computer models of the microwave emission from the earth's atmosphere were used to study the problem of retrieving meteorological information from the SMMR instrument that will be flown on NIMBUS-G. Methods for retrieving rain rate, wind speed, cloud height, and ocean temperature are described for the case when the satellite is over the ocean.

**N78-33542**

National Aeronautics and Space Administration, Washington, D. C.


(Contract NASW-31919)

(NASA-TM-75548; Pr-287) Avail: NTIS HC A04/MF A01 CSCL 04A

Widely used remote probing methods, and especially the multispectral method, for studying the earth from aerospace platforms necessitate the systematization and accumulation of data on the relationships between remote observations and measured parameters and characteristic properties and conditions of phenomena on the earth's surface. Data were presented on the optical characteristics of natural objects which arise during observations of these objects over a wide spectral interval which encompasses solar radiation reflected by the object as well as the object's inherent thermal radiation. The influence of the earth's atmosphere on remote measurements and several problems in simulation and calculation are discussed.

B.B.

Primary applications of remote sensing technology are discussed, including agronomy, agriculture, and cartography. Attention is given to the machine-assisted classification of remote sensing data with reference to biophysical mapping and forest-land classification. Applications of satellite imagery to hydrology are outlined along with techniques for thermal infrared imaging (noting ground surfaces covered with vegetation, sea and ice mapping, and building heat-loss). Various world-wide Landsat applications are discussed and processes for the interpretation of microwave data are outlined. Multispectral studies utilizing remote sensing data are described including the geological reconnaissance of dam sites, the measurement of the vertical distribution of phytoplankton in sea-water, and the remote sensing of chlorophyll. Procedures for making geometric and radiometric adjustments are presented. S.C.S.


Meteosat, the first European weather satellite, was successfully launched on November 23, 1977. The first pictures of the terrestrial disk were provided on December 9, 1977. The Meteosat project was conducted by the European Space Agency. Pictures of the terrestrial surface and the cloud cover in the visible and infrared region are obtained as a basis for the derivation of meteorological information. In a discussion of the possibilities for the application of Meteosat data, attention is given to the measurement of sea surface temperatures, the measurement of ground humidity, applications for agriculture, the administration and surveillance of water resources, the distribution of vegetation zones and their seasonal and climate-related changes, and geologic investigations for the identification of large-scale structures. G.G.


The Line Earthnet Data Availability (LEDA) system created by the Space Documentation Service of the ESA is described. LEDA is a data bank which can be interrogated in real time and in conversational mode by means of terminals connected to the SDS computer. The data acquired can be applied to the interpretation of space images. The scope of data and operations available is explained. M.L.

N78-28577// Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

ECHO USER’S GUIDE

(E78-10172; NASA-CR-157289; LARS-Publ-083077) Avail: NTIS HC A05/MF A01 CSCL 058

N78-28587# Missouri Univ. - Rolla. Dept. of Mining, Petroleum and Geological Engineering.

A MANUAL FOR INEXPENSIVE METHODS OF ANALYZING AND UTILIZING REMOTE SENSOR DATA

(NASA-CR-150731) Avail: NTIS HC A03/MF A01 CSCL 058

Instructions are provided for inexpensive methods of using remote sensor data to assist in the completion of the need to observe the earth’s surface. When possible, relative costs were included. Equipment need for analysis of remote sensor data is described, and methods of use of these equipment items are included, as well as advantages and disadvantages of the use of individual items. Interpretation and analysis of stereo photos and the interpretation of typical patterns such as tone and texture, landcover, drainage, and erosional form are described. Similar treatment is given to monoscopic image interpretation, including LANDSAT MSS data. Enhancement techniques are detailed with respect to their application and simple techniques of creating an enhanced data item. Techniques described include additive and subtractive (Diazo processes) color techniques and enlargement of photos or images. Applications of these processes, including mappings of land resources, engineering soils, geology, water resources, environmental conditions, and crops and/or vegetation, are outlined.

G.G.


TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: PHYSICAL SCIENCES AND TECHNOLOGY. NO. 41
20 Jul. 1978 101 p. refs Transl. into ENGLISH from various Russian journals (JPRS-71512) Copyright. Avail: NTIS HC A06/MF A01 Soviet progress is reported in automation technology, industrial robot use and development, and in satellite observations of earth resources. Oceanographic studies of atmospheric circulation above the Pacific Ocean, and the tectonic structure of its bottom are included.
09 GENERAL


SPACE PHOTOGRAPHY FEATS, OBJECTIVES DESCRIBED

Yuriy Zaytsev In its Transl. on USSR Sci. and Technol. (JPRS-71512) 20 Jul. 1978 p 70-73 Transl. into ENGLISH from Kierunki (Warsaw), no. 27, 2 Jul. 1978 p 3 (For primary document see N78-29032 19-99)

Copyright. Avail: NTIS HC A06/MF A01

Applications of space technology methods in geology, oceanography, hydrology, geobotany, soil science, agrobiology, and forestry are reviewed. The problem of finding various natural resources on earth and of studying phenomena occurring in nature is considered. The basic material for spacebased research of earth resources is either black and white or colored photographs. However, if photographs in the visible part of the spectrum and in the light from infrared radiation are made at the same time, the properties of the objects observed can be better investigated. Irradiation measurements of other wavelengths are also important. By determining the radio temperature of various sectors of the earth's surface, deep-lying layers of the earth's crust may be observed.

A.R.H.

N78-29125# Council for Scientific and Industrial Research, Pretoria (South Africa).

SPACE RESEARCH IN THE REPUBLIC OF SOUTH AFRICA: REPORT TO COSPAR Annual Report F. J. Hewitt May 1978 10 p

Avail: NTIS HC A02/MF A01

Results are given of various experiments and studies conducted in the areas of solar terrestrial physics and satellite remote sensing. Programs in ionospheric sounding, geomagnetism, cosmic rays, and whistlers, VLF, ELF, and auroral emissions are included along with satellite remote sensing of oceanographic parameters. Image processing of LANDSAT data to provide information for forest mapping, antarctic mapping, agricultural land use, and the study of coastal areas is summarized.

J.M.S.

N78-29535# National Aeronautics and Space Administration, Washington, D. C.

SOYUZ 22: NEW CONTRIBUTION TO EARTH STUDY FROM SPACE


(Contract NASw-2792)

(NASA-TM-75055) Avail: NTIS HC A02/MF A01 CSCL 05B

The mission of space flight Soyuz-22 was to develop new and improved methods and means for finding the earth's natural resources from outer space to aid the economy. With the help of the new multispectral space camera, MKF-6, the cosmonauts were able to photograph selected areas of U.S.S.R. and the German Democratic Republic in 4 visible and 2 infrared regions of the spectrum. The MKF-6 can simultaneously photograph areas in 6 spectral regions and register both the natural electromagnetic radiation of surface objects and the solar radiation reflected by them.

L.S.

N78-29548# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme

THE COVERAGE BEHAVIOR OF ERDSAT FOR SOME SELECTED REGIONS OF THE WORLD [UEBERDECKUNGSVERHALTEN DES ERDSAT FUER EINIGE AUSGEWAELHTE GEBIETE AUF DER ERDOBERFLACE]

E. F. Joehim Mar. 1978 72 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-494)

(NLR-B-552-78/1) Avail: NTIS HC A04/MF A01

The coverage behavior of a proposed European remote sensing satellite was investigated for each of its onboard sensors for Europe, the Amazon Basin, Indonesia, and Brazil. The proposed satellite will carry a multispectral scanner and a microwave sensor. It is concluded that the satellite orbit can be optimal only for one sensor for one region on the earth.

ESA

N78-30146# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

SPACELAB MISSION 1 EXPERIMENT DESCRIPTIONS

Paul D. Craven, ed. May 1978 154 p

(NASA-TM-78173: ESA/FSLP-EX-001) Avail: NTIS HC A08/MF A01 CSCL 22A

Brief descriptions of experiments and facilities planned for Spacelab I are presented. These experiments are grouped under the topics of: atmospheric physics and earth observations, space plasma physics, material sciences and technology, astronomy and solar physics, and life sciences.

S.B.S.

N78-30154# National Aeronautics and Space Administration, Washington, D. C.

FIRST IN NEW ENVIRONMENTAL SPACECRAFT SERIES TO BE LAUNCHED

5 Sep. 1978 23 p


A series of operational meteorological monitoring satellites (TIROS-N) is described. Emphasis is placed on environmental monitoring instruments onboard the satellites that provide technological advances over previous sensors. Benefits in the areas of weather forecasting, oceanography, water resource management, and flood forecasting are discussed along with the operational capability to collect and transmit environmental data from platforms on land, at sea, and airborne, and to track stations motion. The participation of Canada, Great Britain, and France is mentioned and a description of the launch vehicle is included.

J.M.S.

N78-31506# National Aeronautics and Space Administration, Washington, D. C.

A SUMMARY OF THE USERS PERSPECTIVE OF LANDSAT AND REFERENCE DOCUMENT OF LANDSAT USERS

A. Donald Goedeke and Alexander J. Tuyahov, Principal Investigator 31 Jan. 1977 330 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls. S. D. 57198 ERTS

(E78-10208: NASA-TM-79744) Avail: NTIS HC A15/MF A01 CSCL 05B

A series of operational meteorological monitoring satellites (TIROS-N) is described. Emphasis is placed on environmental monitoring instruments onboard the satellites that provide technological advances over previous sensors. Benefits in the areas of weather forecasting, oceanography, water resource management, and flood forecasting are discussed along with the operational capability to collect and transmit environmental data from platforms on land, at sea, and airborne, and to track stations motion. The participation of Canada, Great Britain, and France is mentioned and a description of the launch vehicle is included.

J.M.S.

N78-31517# General Accounting Office, Washington, D. C.

LANDSAT POLICY ISSUES STILL UNRESOLVED

17 Apr. 1978 34 p

(PB-279701/7: PSAD-78-58) Avail: NTIS HC A03/MF A01 CSCL 08B

The need to keep the Congress informed on the goals and results of studies relating to satellite-based, remote-sensing policy issues is discussed.

GRA
Experimental demonstrations and workshop instructional courses were conducted to transfer the technology of satellite remote sensing to a wide audience of resource managers. This audience included planning commissions, state agencies, federal agencies, and special councils of the Governor. Some of the experiments and workshops are outlined.

J.M.S.
The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by two hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section of this supplement. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.
LAND MANAGEMENT
The mapping of ecological land units of Labrador utilizing LANDSAT imagery
Use of manual density in land cover classification

LAND USE
Evaluation of a semiautomatic interpretation method for the cartography of cleared zones in the southern James Bay area
Use of topographic data for land-cover identification by LANDSAT imagery
Computer processing of LANDSAT data as a means of mapping land use for the Canada land inventory
The use of LANDSAT imagery in a land system classification of Jordan
Studies utilizing orbital imagery of India for geology and land use
LANDSAT digital data application for forest vegetation and land-use classification in Minnesota
Soil resources and potential for agricultural development in Bahir El Jelab in southern Sudan. Jungol project area

LINEARITY
Linear feature selection with applications

LITHOLOGY
Soil: Soil moisture in relation to geologic structure and lithology, Northern California

M
MAGNETIC TRANSDUCERS
Magnetometer with a miniature transducer and automatic scanning

MAGNETOMETERS
Magnetometer with a miniature transducer and automatic scanning

MAIN SOLAR
Satellite imagery analysis of snow cover in the Saint John and Soure Rivers basin
Computer processing of LANDSAT digital data and sensor intercomparison for development in New England reservoir management

MANAGEMENT INFORMATION SYSTEMS
Ocean information and management systems

MANITOBIA
Satellite geology in the Pas area of Manitoba - Application of digital LANDSAT data
Satellite imagery analysis of snow cover in the Saint John and Soure Rivers basin

MANUALS
A manual for inexpensive methods of analyzing and utilizing remote sensor data

MAPPING
Evaluation of a semiautomatic interpretation method for the cartography of cleared zones in the southern James Bay area
Space research in the Republic of South Africa: Report to COSPAR --- on solar terrestrial physics and satellite remote sensing
First geologic map to the millionth scale

MARINE METEOROLOGY
Recent progress in earth satellite data applications to marine activities
Translations on USSR science and technology. Physical sciences and technology, no. 41

MARINE RESOURCES
Estimate of suspension and chlorophyll concentrations in the sea from the spectrum of the emerging radiation measured from a helicopter

MARINE TECHNOLOGY
Research in the sea from the spectrum of the emerging radiation measured from a helicopter

MARINE TECHNOLOGIES
Ocean research and development systems

MARINE RESOURCES
Estimate of suspension and chlorophyll concentrations in the sea from the spectrum of the emerging radiation measured from a helicopter
Translations on USSR science and technology. Physical sciences and technology, no. 41

MARITIME SATELLITES
Recent progress in earth satellite data applications to marine activities

MATHEMATICAL MODELS
A joint topside-bottomside remote sensing experiment on Arctic sea ice
Effect of sea-state on the performance of laser fluorosensors --- for oceanographic parameter and marine pollution remote sensing
An interactive correction and analysis system for in-bore laser profiles of sea ice
Determining crustal strain rates with spaceborne geodynamics ranging system data
A baseline analysis

MATERIAL RANGED FINDERS
Detection of crustal motion using spaceborne laser ranging systems

METEOROLOGICAL SATELLITES
Recent observations of the Alboran Sea frontal system
Groundwater studies in arid regions in Egypt using LANDSAT satellite images
Recent progress in earth satellite data applications to marine activities
METEOROLOGICAL SERVICES

First in new environmental spacecraft series to be launched


METEOROLOGICAL SATELLITES

Possible applications of Meteosat for remote sensing

[267 A78-43636]

MINERING

Diffuse backscatter of solar radiation

[2058 A78-43356]

MICROWAVE ANTEENNAS

Estimates of brightness temperatures from scanning radiometer data — antenna temperature maps of earth

[2074 A78-49440]

MICROWAVE EMISSION

Remote sensing of rain over the ocean

[2076 N78-35153]

MICROWAVE RADIOMETERS

A case study comparison of microwave radiometer measurements over bare and vegetated surfaces

[2073 A78-45023]

A multifrequency radiometer system — ice sensing application

[2074 A78-45144]

Determination of earth soil moisture by means of microwave radiometry /Review/

[2074 A78-53732]

Geosynchronous Microwave Atmospheric Sounder Radiometer (MARS) feasibility study, Volume 1: Management summary

[2076 N78-30748]

Geosynchronous Microwave Atmospheric Sounder Radiometer feasibility study, Volume 2: Radiometer receiver feasibility

[2076 N78-30749]

MICROFAX SCATTERING

Remote sensing of sea state by analysis of backscattered microwave phase fluctuations

[2076 N78-29203]

MICROFAX SENSORS

Microwave sensing of sea surface wave patterns

[2045 A78-43339]

Central swath mapping by a future satellite-borne microwave scatterometer for imaging global ocean wind fields

[2042 A78-45750]

Research of microwave scattering properties of snow fields

[2042 A78-45945]

MINERAL DEPOSITS

Geologic processing: Geologic applications

[2042 A78-27067]

Project geological map to the millionth scale

[2042 N78-1001]

A study of alteration associated with uranium occurrences in western Colorado and its detection by remote sensing methods, volume 1 — spectral reflectance of rocks in Utah and Wyoming

[2042 N78-31512]

A study of alteration associated with uranium occurrences in western Colorado and its detection by remote sensing methods, volume 2 — spectral reflectance of rocks in Utah and Wyoming

[2042 N78-31512]

A special kind of strippable coal reserve and mine inventory in part of the Warrior Coal Field in Alabama

[2042 N78-31508]

MINERAL EXPLORATION

Remote-sensing applications for mineral exploration

[2042 A78-53377]

Remote-sensing applications for mineral resources

[2042 A78-53380]

Exploration for fossil and nuclear fuels from orbital altitudes

[2042 A78-53382]

The role of remote sensing for energy development

[2042 A78-53383]

Digital enhancement of Landsat MSS data for mineral exploration

[2042 A78-53384]

Application of Landsat satellite imagery for iron ore prospecting in the western desert of Egypt

[2042 A78-53383]

Regional prospecting for iron ores in Bahariya Oasis-Ell Fanum area, Egypt, using LANDSAT-1 satellite images [ILS]

[2042 A78-53384]

MINERALOGY

[2042 A78-53388]

MINERALOGY

[2042 A78-53387]

MINERALOGY

The process of clay mineralogy to landscape stability in Western Oregon

[2042 N78-33500]

MINERALOGY

[2042 A78-53149]

MINES (EXCAVATIONS)

Locally connected structures works dealing with the application of LANDSAT imagery in the survey of mineral resources

[2042 A78-10942]

Monitoring corn and soybean crop development by remote sensing techniques

[2042 A78-30634]

MINES (EXCAVATIONS)

[2042 A78-30631]

APPLICATION OF LANDSAT IMAGERY IN THE SURVEY OF MINERAL RESOURCES IN WESTERN OREGON

[2042 N78-35153]

Remote sensing of strippable coal reserves and mine inventory in the Warrior Coal Field in Alabama

[2042 N78-35152]

MINERALOGY

[2042 A78-31490]

Monitoring of the users perspective of LANDSAT-D and reference document of LANDSAT users

[2042 A78-31508]
A study of snowmelt progression from Winnepeg to the Arctic Islands using ERTS photography.

Use of topographic data for land-use land-cover identification by Landsat imagery.

The Centre for Remote Sensing's image analysis system.

The activities of the Groupement pour le Development de la TeleDetection Aerospatiale /GDTA/.

The mapping of ecological land units of Labrador utilizing Landsat imagery.

Specific study of rice cultivation by remote sensing - ranging in the Sao Francisco river area.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Use of topographic data for land-use land-cover identification by Landsat imagery.

The activities of the Groupement pour le Development de la TeleDetection Aerospatiale /GDTA/.

The mapping of ecological land units of Labrador utilizing Landsat imagery.

Use of a remote computer terminal during field checking of Landsat digital maps.

Remote sensing of mineral-related industries.

Experience in operational processing of geophysical data.

Use of manual densitometry in land cover classification.

Extraction of rich-plankton area off-the northern Japan.

A study of snowmelt progression from Winnipeg to the Arctic Islands using ERTS photography.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.

Remote sensing of atmospheric pollution from space.
SCATTEROMETERS

Central swath mapping by a future satellite-borne fan-beam microwave scatterometer for ocean wind fields

[2024 A75-45750]

Detection of crustal motion using spaceborne laser ranging system

[2024 A75-48001]

Estimation of brightness temperature from spaceborne radiometer data --- antenna temperature maps of earth

[2024 A75-49440]

Monitoring the effects of Gulf Stream on meterological 
eddies on the New England fishing grounds

[2024 A75-49658]

Determining crustal strain rates with spaceborne geodynamics ranging system. 1: Baseline analysis

[2023 A78-30755]

SATELLITE BORNE PHOTOGRAPHY

Satellite image analysis of snow cover in the Saint John River basin of New Brunswick

[2024 A78-43163]

A study of snowmelt progression from Winnipeg to the Arctic Islands using ERIS photography

[2024 A75-43317]

A study on the interpretation of regional soil moisture using satellite image

[2024 A78-53345]

Use of topographic data for land-use land-cover identification by Landsat imagery

[2024 A78-53419]

Computer generated control points for two dimensional image

[2024 A78-53353]

Diffuse backscatter of solar radiation

[2024 A78-53356]

Application of space-borne photography to mapping and investigation of earth resources

[2024 A78-53359]

Application of multispectral aerial photographs to soil inventory

[2024 A78-53362]

Digital processing of meteorological satellite /NOAA/ images

[2024 A78-53365]

Image processing in remote sensing --- from aerial survey and satellite observation

[2024 A78-53388]

A methodology for employing Landsat data for rural land use surveys in developing countries

[2024 A78-54235]

A key study on the interpretation of regional soil moisture using satellite imagery

--- Remote sensing applications for mineral resources exploration

[2024 A78-54336]

Summary of Landsat applications and results

[2024 A78-53393]

Remote-sensing applications for mineral resources exploration

[2024 A78-53397]

Earth observations from remote sensing platforms - Towards a satellite-based information service

[2024 A78-53390]

Exploration for fossil and nuclear fuels from orbital observations

[2024 A78-53403]

A key study on the interpretation of regional soil moisture using satellite imagery

[2024 A78-53402]

Application of Landsat imagery to shoreline erosion

[2024 A78-53403]

Satellite imagery interpretation: Suggestions for laboratory design

[2024 A78-53401]

Remote-sensing applications for mineral resources exploration

[2024 A78-53400]

Satellite imagery interpretation: Suggestions for laboratory design

[2024 A78-53400]

A methodology for employing Landsat data for rural land use surveys in developing countries

[2024 A78-53402]

Remote-sensing applications for mineral resources exploration

[2024 A78-53403]

A key study on the interpretation of regional soil moisture using satellite imagery

[2024 A78-53402]

Remote-sensing applications for mineral resources exploration

[2024 A78-53403]
Application of LANDSAT satellite imagery for iron ore prospecting in the western desert of Egypt [E78-10165]

LANDSAT satellite mapping in Egypt and its possible applications in petroleum and natural gas exploration [E78-2042] [E78-2857]

A study of the Tyrean Mount Union lineament by remote sensing techniques and field methods [E78-10155]

[SUBARCTIC REGIONS]

Biophysical mapping in northwestern Ontario from aircraft and satellite remote sensing data [E78-10152]

BUHAN

Satellite mapping: Regional geography, geomorphology, structure, drainage and hydrology of Bahri El Jebel area, Jingle Canal project area, southern Sudan [E78-10160]

Use of LANDSAT data to identify and evaluate areas of sugar cane [E78-10184]

[GREENHOUSE EFFECTS]

Determination of various topographies using photographic texture analysis of LANDSAT data [E78-10196]

SUGAR BEETS

Atlas of selected crop spectra. Imperial Valley, California [P0233 N78-31499]

SUGAR CANE

INPE’s crop survey program using combined LANDSAT and aircraft data [E78-10184]

Use of LANDSAT data to identify and evaluate areas of sugar cane [E78-10184]

[SURFACE TEMPERATURE]

A survey of worldwide sea surface temperature fronts detected by environmental satellites [P0245 A78-52152]

A winter cycle of sea surface temperature of the Pacific Ocean [P0246 A78-52153]

Scales of motion in the subtropical convergence zone — sea surface temperature pattern evolution [P0249 A78-52158]

[THERMAL MAPPING]

A study of the Tyrone-Mount Union lineament by remote sensing and soil investigations in the control western desert, Egypt [E78-10168]

Application of LANDSAT satellite imagery for iron ore prospecting in the western desert of Egypt [E78-10165]

LANDSAT satellite mapping in Egypt and its possible applications in petroleum and natural gas exploration [E78-2042] [E78-2857]

A study of the Tyrean Mount Union lineament by remote sensing techniques and field methods [E78-10155]

[SYSTEMS ENGINEERING]

Advanced Multispectral Scanner (AMS) study — aircraft remote sensing

[SYSTEMS ENGINEERING]

Advanced Multispectral Scanner (AMS) study — aircraft remote sensing

[SPECTRAL RADIATORS]

Crop discriminability in the visible and near infrared regions [P0231 A78-58649]

[SPECTRAL RADIATORS]

Effects of systemic and non-systemic stresses on the thermal characteristics of crop [P0232 A78-29537]

[SPECTRAL RADIATORS]

Infrared and visible ratio polarization spectrometer [P0233 N78-31498]

[SPECTRAL RADIATORS]

Effect of remote measurement of the vertical distribution of phytoplankton in surface sea [P0246 A78-43349]

[SPECTRAL RADIATORS]

A spectral method for determining the percentage of live and dead material in clipped samples [P0246 A78-43349]

[SPECTRAL RADIATORS]

Visible and infrared polarized ratio spectrometer [P0233 N78-31498]

[SPECTRAL RADIATORS]

Manual for the application of NUSE 1974-1977 aerial gamma ray spectrometers data [P0244 N78-29421]

[SPECTRAL RADIATORS]

Application of LANDSAT satellite imagery for iron ore prospecting in the western desert of Egypt [E78-10165]

LANDSAT satellite mapping in Egypt and its possible applications in petroleum and natural gas exploration [E78-2042] [E78-2857]

A study of the Tyrean Mount Union lineament by remote sensing techniques and field methods [E78-10155]

[SUBARCTIC REGIONS]

Biophysical mapping in northwestern Ontario from aircraft and satellite remote sensing data [P0237 A78-43307]

[THERMAL MAPPING]

Application of LANDSAT satellite imagery for iron ore prospecting in the western desert of Egypt [E78-10165]

LANDSAT satellite mapping in Egypt and its possible applications in petroleum and natural gas exploration [E78-2042] [E78-2857]

A study of the Tyrean Mount Union lineament by remote sensing techniques and field methods [E78-10155]

[STABLE ISOTOPE ANALYSIS]

Determination of various topographies using photographic texture analysis of LANDSAT data [E78-10196]

[STORMS]

Spectra of optical and infrared linear combinations for soybean [P0265 N78-29544]

[SUBARCTIC REGIONS]

Biophysical mapping in northwestern Ontario from aircraft and satellite remote sensing data [P0217 A78-43307]

BUHAN

Satellite mapping: Regional geography, geomorphology, structure, drainage and hydrology of Bahri El Jebel area, Jingle Canal project area, southern Sudan [E78-10160]

[SUBARCTIC REGIONS]

Biophysical mapping in northwestern Ontario from aircraft and satellite remote sensing data [P0237 A78-43307]

[SUBARCTIC REGIONS]

Biophysical mapping in northwestern Ontario from aircraft and satellite remote sensing data [P0217 A78-43307]

BUHAN

Satellite mapping: Regional geography, geomorphology, structure, drainage and hydrology of Bahri El Jebel area, Jingle Canal project area, southern Sudan [E78-10160]

[SUBARCTIC REGIONS]

Biophysical mapping in northwestern Ontario from aircraft and satellite remote sensing data [P0217 A78-43307]

BUHAN

Satellite mapping: Regional geography, geomorphology, structure, drainage and hydrology of Bahri El Jebel area, Jingle Canal project area, southern Sudan [E78-10160]

[SUBARCTIC REGIONS]

Biophysical mapping in northwestern Ontario from aircraft and satellite remote sensing data [P0217 A78-43307]
SUBJECT INDEX

Estimation of rates of frontogenesis and frontolysis in the North Pacific Ocean using satellite and surface meteorological data from January 1977
[0249 A78-52155]

Scales of motion in the subtropical convergence zone
Recent observations of the Alboran Sea frontal system
Fronts on the continental shelf
[0249 A78-52158]

Microwave sensing of sea surface wave patterns
Remote sensing of sea state by analysis of backscattered microwave phase fluctuations
Ocean wave sensing. A bibliography with abstracts
Remote sensing of the ocean. Part 2: Dynamics. A bibliography with abstracts
[0250 N78-30795]

Evaluation of wavelength groups for discrimination of agricultural cover types — remote sensing of environment in INDIANA
[0253 N78-31499]

Geosynchronous Microwave Atmospheric Sounding Radiometer (MASR) feasibility studies. Volume 1: Management summary
Geosynchronous Microwave Atmospheric Sounding Radiometer (MASR) feasibility study. Volume 2: Radiometer receiver feasibility
[0255 N78-30749]

Vegetation classification with digital X-band and L-band dual polarized SAR imagery
A technique for evaluating inland wetland photointerpretation - The call analytical method /CAM/
[0256 N78-48006]

Global agricultural productivity estimation from Landsat data
Plant canopy light absorption model with application to wheat
Crop forecasting by satellite: Progress and problems
Assessment of the damage caused by the frost of 1975 to coffee and wheat crops in the northwest of the state of Parana using LANDSAT images with automatic classification
Analytical techniques for the study of some parameters of multispectral scanner systems for remote sensing
Atlas of selected crop spectra, Imperial Valley, California
[0279 A78-43305]

Nationwide forestry applications program: Procedure 1 applicability to rangeland classification — Weld County, Colorado
Linear feature selection with applications
Analysis of scanner data for crop inventories
[0232 N78-29561]

Remote sensing of atmospheric water vapor, liquid water and wind speed at the ocean surface by passive microwave techniques from the Nimbus-5 satellite
[0260 N78-33512]

Remote sensing of atmospheric water vapor, liquid water and wind speed at the ocean surface by passive microwave techniques from the Nimbus-5 satellite
[0260 N78-33512]

Crop forecasting by satellite: Progress and problems
[0232 N78-29561]

Crop forecasting by satellite: Progress and problems
[0232 N78-29561]
PERSONAL AUTHOR INDEX

DOSSANTOS, A. R.
ELSHAZY, C. M.
EUCASSAS, I. A.
EUFRITS, C. D.
ELGIN, J. M., JR.

PERSONAL AUTHOR INDEX

EGBERT, D.
EAV.

Jonglei Canal project area, southern Sudan
[INPE-1074-NTE/100] p0241 N78-28566

structure, drainage and hydrology of Bahr El Jebel area,
[INPE-1074-NTE/100] p0242 N78-29540

the Qattara Depression area, Egypt


Jonglei Canal project area, southern Sudan


in the Sao Francisco river area,


[INPE-1074-NTE/100] p0247 N78-28574

Geologic interpretation of LANDSAT satellite images for

Jonglei Canal project area, southern Sudan


the Qattara Depression area, Egypt


Applications of LANDSAT satellite images

in the Sao Francisco river area

[infrared thermal profiles and

Remote sensing /infrared thermal profiles and

APPLICATION OF LANDSAT SATELLITE SATELLITE IMAGERY IN THE GEOLOGICAL AND

atmospheric sounding

Geosynchronous Microwave Atmospheric Sounding

Raeder, M. C.

FERNANDEZ, D.

GODFELLOW, C.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.

GORDON, R. H.
HIXSON, M. M.

B 4

HORV, P. G.

Rain estimation from geosynchronous satellite imagery: Validation and infrared studies

[PSA: 49531]

GIUDEN, P. H.

Methodology for assessing the potential impact on air quality resulting from geothermal resource development in the Imperial Valley

[ULR: 79388]

GUILLIER, M. N.

The activities of the Groupement pour le Development de la Teledetection Aerospatiale /GDTA/ &[PSA: 43237]

GURGANUS, E. A.

Laboratory and field measurements of upward radiated and reflectance spectra of suspended James River sediments near Hopewell, Virginia

[NASA-TP: 1292]

GUEPAPS, L. F.

Linear feature selection with applications to the earth sciences

[PSA: 31504]

GUY, J.

The activities of the Groupement pour le Development de la Teledetection Aerospatiale /GDTA/ &[PSA: 43237]

HABA, G.

Remote ocean environmental data acquisition

[PSA: 48652]

HALLEY, R. A.

Retransmission of hydrometric data in Canada

[E78-10174]

CRREL: 1977

GORTON, W.

Retransmission of hydrometric data in Canada

[E78-10179]

Gorton, W.

A plan for the collection and transmission of hydrometeorological data in the Brazilian Amazon basin

[E78-10175]

HAMDAD, M. A.

Soil resources and potential for agricultural development in Bahri El Jebel in southern Sudan, Jonglei Canal project area

[E78-10161]

HANNAH, M. C.

Use of manual densitometry in land cover classification

[PSA: 49787]

HANOLD, R. J.

Geothermal reservoir categorization and stimulation study

[LA-6889-MS]

HARRAH, A. A.

Application of LANDSAT imagery in the geological and soil investigations in the control western desert. Egypt

[E78-10160]

HARDY, J. R.

Methods and accuracy of location of LANDSAT MSS points

[PSA: 44237]

HARRIES, J. E.

Remote sensing of atmospheric pollution from space

[PSA: 37025]

HELMCK, D.

The geometrical interpretation of the Tiberi from LANDSAT-1 imagery /Republic of Chad/ - Explanations regarding the map Tiberi 1:1,000,000

[PSA: 43639]

HINZEND, P. E.

Automatic classification of reforested Pinus SPP and Eucalyptus SPP in Mogi-Guacu, SP, Brazil, using LANDSAT data

[E78-10167]

HERMAN, M. S.

Geosynchronous Microwave Atmospheric Sounding Radiometer (MASR) feasibility study. Volume 2: Radiometer receiver feasibility

[NASA-IR: 156805]

HERZ, R.

Surface hydrodynamical models through synoptic interpretation of LANDSAT MSS images in lagonal and coastal waters

[E78-10188]

HEWITT, F. J.

Space research in the Republic of South Africa: Report to COSPAR

[PSA: 29125]

HILDE, T.

Evaluation of orbital sizes as a basis for land utilization

[E78-10187]

HOLLOWAY, M. M.

Use of LANDSAT imagery for soil survey

[E78-10189]

HIXSON, R.

Area estimation of crops by digital analysis of LANDSAT data

[PSA: 48005]

HOFER, R.

A study of snowmelt progression from Winnipeg to the Arctic Islands using ERTS photographs

[PSA: 43317]

HOLMQVIST, K. W.

The use of satellite imagery for lake classification in Wisconsin

[PSA: 29558]

HORD, R. M.

Digital enhancement of LANDSAT MSS data for mineral exploration

[PSA: 53378]

HOWDEN, B.

Earth observation from remote-sensing platforms - Outlook

[PSA: 53381]

HOWARTH, P. J.

Biophysical mapping in north-western Ontario from aircraft and satellite remote sensing data

[PSA: 52164]

HUBSCH, R.

Large-scale Gulf Stream frontal study using GESD 3 radar altimeter data

[PSA: 53323]

HUH, O. E.

Winter cycle of sea surface thermal patterns. northeastern Gulf of Mexico

[PSA: 33696]

HUNDEMEER, A. B.

Ocean wave sensing. A bibliography with abstracts

[PSA: 30795]

HUNT, R.

Remote sensing applied to hydrology. A bibliography

[PSA: 30795]

HUNDLOW, G. W.

Survey of NOAA satellite data availability from Environmental Information Service

[PSA: 49873]

HUBBARD, E. C.

The TIROS-N polar orbiting-environmental satellite system

[PSA: 29139]

HUTTON, R.

A synthetic aperture radar SAR/ program for environmental and resource management in Canada

[PSA: 48514]

IANNACCI, J. R.

Near real time application of digital terrain data in a minicomputer environment

[PSA: 29545]

IARN, F. J.

The role of remote sensing for energy development

[PSA: 53383]

JAIN, B. C.

Some observations about LANDSAT digital analysis

[NASA-IR: 156814]

JACOB, E. F.

The coverage behavior of ERDSAT for some selected regions of the world

[PSA: 29548]

JACOBI, J. A.

Application of space-borne photography to mapping and environmental and resource management in Canada

[PSA: 48319]

JAIN, S. C.

Landscat atmospheric corrections at CORS

[PSA: 43355]

JANGA, J. R.

Application of LANDSAT imagery in the geological and soil investigations in the control western desert. Egypt

[E78-10160]

JANSEN, J. L.

Application of LANDSAT imagery in the geological and soil investigations in the control western desert. Egypt

[E78-10167]

JAROS, M. R.

Regional prospecting for iron ores in Bahr El Falam S.D., Egypt, using LANDSAT-1 satellite images

[PSA: 37849]

JIAO, Y. C.

A synthetic aperture radar SAR/ program for environmental and resource management in Canada

[PSA: 48344]

JIBBEN, B. V.

Application of space-borne photography to mapping and environmental and resource management in Canada

[PSA: 37849]

KAMER, R.

Remote sensing applied to hydrology. A bibliography

[PSA: 53383]

KILEY, V. V.

Remote sensing of coal resources in Minnesota

[PSA: 37777]

KIM, J.

A study of snowmelt progression from Winnipeg to the Arctic Islands using ERTS photographs

[PSA: 43317]

KING, R.

Remote sensing of coastal pollutions

[PSA: 37521]

KINGSTON, A. J.

Soil resources and potential for agricultural development in Bahri El Jebel in southern Sudan, Jonglei Canal project area

[E78-10161]

KING, C. R.

Remote multipixel imaging for nearshore bathymetry

[PSA: 48667]

KOFLER, M. F.

Automatic classification of reforested Pinus SPP and Eucalyptus SPP in Mogi-Guacu, SP, Brazil, using LANDSAT data

[PSA: 37579]

KRAUS, A.

Biophysical mapping in north-western Ontario from aircraft and satellite remote sensing data

[PSA: 34307]

KRUPKA, J.

Detection of crustal motion using spaceborne laser ranging systems

[PSA: 45924]
LA VIOLETTE, P. E.  
Thermal studies of the Grand Banks Gulf Stream slope using airborne radiation thermometers and satellite data  

LACAZE, B.  
Utilization of LandSat data for ecological studies of the arid zones of Tunisia [The Arzotu experiment]  

LADDUCUE, G.  
Remote sensing of sea ice  

LA/icona, M.  
Analysis of scanner data for crop inventories  
[INPE-1074-NTE/100] p0235 N78-33675

LAIMBECK, P. F.  
Analysis of scanner data for crop inventories  
[INPE-1074-NTE/100] p0235 N78-31505

LAMBORN, K. C.  
Methodology for assessing the potential impact on air quality resulting from geothermal resource development in the Imperial Valley  
[UCRL-53968] p0235 N78-28665

LANCU, N.  
Atlas of selected crop spectra. Imperial Valley, California  
[INPE-1074-NTE/100] p0233 N78-31499

LANDE. R.  
Methodology for assessing the potential impact on air quality resulting from geothermal resource development in the Imperial Valley  
[UCRL-53968] p0235 N78-28665

LANGHAN, E. J.  
Water dynamics at Lac Saint Jean, Quebec based on Landsat 1 and Landsat 2 data  
[INPE-1074-NTE/100] p0235 N78-33392

LAPCZAK, S.  
Enhancement of linear features by rotational exposure  
[INPE-1111-TPT/064] p0243 N78-30638

LAPCZAK, S.  
A technique for evaluating inland wetland photointerpretation - The call analytical method /CAM/  
[INPE-1074-NTE/100] p0244 N78-49006

LAVOIE, R.  
Existence of operational geophysical processing of the data with the D-GU 2 plotter  
[INPE-1074-NTE/100] p0244 N78-49765

LEITAG, C. D.  
Large-scale Gulf Stream frontal study using GOES 3 radar altimeter data  
[INPE-1111-TPT/064] N78-31480

LEMASTER, E. W.  
Plant canopy flight absorption model with application to Landsat data  
[INPE-1111-TPT/064] p0230 N78-47320

LEKMAA, A.  
Available remote sensor imagery  
[AD-A055762] p0235 N78-31513

LEIGH, M. L.  
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management  
[AD-A055762] p0235 N78-31513

LEIBOV, M. B.  
A parametric multiclass Bayes error estimator for the multispectral scanner spatial model performance evaluation  
[INPE-107178] p0244 N78-32540

LEIRMAN, E. W.  
Atlas of selected crop spectra. Imperial Valley, California  
[INPE-1074-NTE/100] p0244 N78-49085

LEITAG, C. D.  
CROP discriminability in the visible and near infrared  
[INPE-1074-NTE/100] p0244 N78-49085

LIMA, J. C.  
CROP discriminability in the visible and near infrared  
[INPE-1074-NTE/100] p0244 N78-49085

LIPPO, C. F.  
The geographical interpretation of the Tien Shan - image /Republic of Chad/ - Explanations regarding the map Tien Shan 1:1.000.000  
[INPE-1074-NTE/100] p0235 N78-43639

LITCH, F. C.  
The geographical interpretation of the Tien Shan - image /Republic of Chad/ - Explanations regarding the map Tien Shan 1:1.000.000  
[INPE-1074-NTE/100] p0235 N78-43639

LUC, C.  
The geographical application of LandSat imagery in Brazil  
[INPE-1111-TPT/064] p0243 N78-30638

LUMINOUS, S.  
Remote ocean environmental data acquisition  
[INPE-1111-TPT/064] p0247 N78-49652

LUTS, A. J. R.  
Applications of remote sensing to hydrologic planning of the Upper Missouri river basin  

MACDONALD, H.  
A parametric multiclass Bayes error estimator for the multispectral scanner spatial model performance evaluation  
[INPE-107178] p0244 N78-32540

MACLENDON, F. J.  
A computer program using combined LANDSAT and airborne data  
[INPE-108184] p0233 N78-31483

MACKEY, E. R.  
Use of LANDSAT data to identify and evaluate areas of sugar cane  
[INPE-108186] p0233 N78-31485

MADDISON, G. P.  
Project geological map to the one thousandth scale  
[AD-A055762] p0235 N78-31513

MANGELLI, R.  
Remote sensing applied to regional geological mapping in the San Francisco river area  
[INPE-1111-TPT/064] p0243 N78-30638

MARCUS, E. P.  
Remote sensing applied to regional geological mapping in the San Francisco river area  
[INPE-1111-TPT/064] p0243 N78-30638

MARTIN, D. W.  
Atlas of selected crop spectra. Imperial Valley, California  
[INPE-1074-NTE/100] p0244 N78-49085

MAY, J. R.  
Guidance for application of remote sensing to environmental management. Appendix A: Sources of available remote sensor imagery  
[AD-A055762] p0235 N78-28588

MCCAIN, P. P.  
Recent progress in earth satellite data applications to marine activities  
[INPE-1111-TPT/064] p0248 N78-49656

MCDONALD, H.  
A parametric multiclass Bayes error estimator for the multispectral scanner spatial model performance evaluation  
[INPE-107178] p0244 N78-32540

MCQUESTEN, C. J. E. III.  
Monitoring corn and soybean crop development by remote sensing techniques  
[INPE-78-0207] p0230 N78-30639

MCQUILLAN, A. K.  
Ocean information and management systems  
[INPE-1074-NTE/100] p0245 N78-43315

MEAD, R. A.  
LANDSAT digital data application to forest vegetation and land classification in Minnesota  
[AD-A055762] p0231 N78-28559

MEIBNER, R.  
The geological interpretation of the Tien Shan - image /Republic of Chad/ - Explanations regarding the map Tien Shan 1:1.000.000  
[AD-A055762] p0235 N78-43639

MENDONCA, F. J.  
A computer program using combined LANDSAT and airborne data  
[INPE-108184] p0233 N78-31483

MENDEZ, R. J.  
The average frequency of rainfall in the Amazon tropical forests of Northern Thailand using LANDSAT imagery  
[INPE-1111-TPT/064] p0243 N78-30638

MERRIMAN, N. D. O.  
Detection of image boundaries: Mathematical models  
[INPE-107178] p0235 N78-43649

MERRIT, M. C.  
Computer processing of LANDSAT digital data and sensor interface development for use in New England reservoir management  
[AD-A055762] p0235 N78-31513

MERTZ, G. G.  
Landdata availability from the EROS data center and status of future plans  
[AD-A055762] p0235 N78-49854

MILLER, M. L.  
Analysis of the dynamics of shifting cultivation in the tropical forests of Northern Thailand using LANDSAT modeling and classification of LANDSAT imagery  
[INPE-107178] p0235 N78-29534

MILLER, B. H.  
Geologic application of thermal-inertia mapping from satellite  
[AD-A055762] p0235 N78-33257

MITCHELL, C. W.  
The use of LANDSAT imagery in a land system classification project  
[INPE-107178] p0243 N78-32517

MOORE, W. R.  
Project geological map to the milliradian scale  
[AD-A0554008] p0237 N78-29545
VOORHIS, A. D.

VOORHIS, A. D.
Scales of motion in the subtropical convergence zone
p0249 A78-52158

VUILLAME, Y.
The activities of the Groupement pour le Developpement
de la Tele detection Aerospatiale /GDTA/
p0263 A78-43227

W

WADHAM, P.
A joint topside-bottomside remote sensing experiment
on Arctic sea ice
p0245 A78-43340

WAITE, W. P.
Preliminary geologic evaluation of L-band radar imagery:
Arkansas test site

WARNE, D. K.
Landsat as an aid in the preparation of hydrographic
charts
p0264 A78-48091

WATANABE, K.
Extraction of rich-plankton area off the northern Japan from
Ssky lab multispectral pictures
p0248 A78-47084

WATSON, K.
Geologic application of thermal-inertia mapping from
satellite
[E78-10212] p0243 N78-25157

WECKBURG, G. W.
Technique for dynamic range reduction for LANDSAT
ratio images
[LA-UR-78-347] p0250 N78-29546

WEESER, W. F.
Differences in radar return from ice-covered North Slope
Lakes
p0254 A78-48076

WEISSMAN, D. E.
Detection and interpretation of ocean roughness
variations across the Gulf Stream inferred from radar cross
section observations
p0248 A78-49657

WELBY, C. W.
Application of Landsat imagery to shoreline erosion
p0254 A78-53548

WHILOCK, C. H.
Laboratory and field measurements of upwelled radance
and reflectance spectra of suspended James River
sediments near Hopewell, Virginia
[NASA-TP-1292] p0256 N78-33616

WHITE, J. R.
U.S. Coast Guard utilization of remote sensing techniques
for ocean surveillance
p0248 A78-49665

WIESNET, D. R.
Applications of HCMM data to soil moisture snow and
estuarine current studies
[E78-10211] p0256 N78-32516

WILHEIT, T. T.
Remote sensing of atmospheric water vapor, liquid water
and wind speed at the ocean surface by passive microwave
techniques from the Nimbus-5 satellite

WILLIAMS, D. L.
Ecosystem mapping by interpretation of landscapes from
satellite imagery
p0238 N78-33503

WILLIAMS, B.
Application of multispectral radar and LANDSAT imagery
to geologic mapping in death valley

WILKINSON, V. R.
The Skylab S191 spectrometer experiment: Analysis of
data and their applications to the earth sciences

WILSON, C. L.
Multispectral data restoration study
[NASA-CR-156790] p0260 N78-28585

WISEMAN, W. J., JR.
Winter cycle of sea surface thermal patterns, northeastern
Gulf of Mexico
p0249 A78-52153

WISEWELL, E. R.
Analytical techniques for the study of some parameters of
multispectral scanner systems for remote sensing
[E78-10200] p0233 N78-31498

WITTE, W. G.
Laboratory and field measurements of upwelled radiance
and reflectance spectra of suspended James River
sediments near Hopewell, Virginia
[NASA-TP-1292] p0256 N78-33616

WOODLEY, W. L.
Rain estimation from geosynchronous satellite imagery
- Visible and infrared studies
p0254 A78-49531

WORCESTER, R. K.
Soil resources and potential for agricultural development
in Bahrain in southern Sudan, Jonglei Canal project
area
[E78-10161] p0231 N78-28566

WORSFOLD, R. D.
Thermal studies of the Grand Banks Gulf Stream slope
using airborne radiation thermometers and satellite data
p0245 A78-43320
**Typical Corporate Source Index Listing**

**ACADEMY OF SCIENTIFIC RESEARCH AND TECHNOLOGY, CAIRO (EGYPT).**
- Geological of Kharga-Dakhla Oases area, western desert, Egypt from LANDSAT-1 satellite images
- [NASA-CR-152124] p0262 N78-32522

**ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N. H.**
- Differences in radar return from ice-covered North Slope Lakes
- Description of the coverage field of earth observation satellites at the earth surface.

**ARMY ENGINEER TOPOGRAPHIC LABS., FORT BELVOIR, VA.**
- Near real time application of digital terrain data in a microcomputer environment
- Description of the coverage field of earth observation satellites at the earth surface.

**bery University Press**
- Basic principles of remote sensing and their applications in petroleum and natural gas exploration
- Region of the world

**BARNES ENGINEERING CO., WALTHAM, MASS.**
- Advanced Multispectral Scanner (AMS) study
- Propagation of microwave scattering properties of snow

**BRITISH LIBRARY LENDING DIV., BOSTON SPA (ENGLAND).**
- Methodology for assessing the potential impact or air quality resulting from geothermal resource development in the Imperial Valley

**CALIFORNIA UNIV., BERKELEY.**
- Research of microwave scattering properties of snow fields
- LANDSAT satellite mapping in Egypt and its possible applications in petroleum and natural gas exploration

**COMMISSION OF THE EUROPEAN COMMUNITIES, ISPRA (ITALY).**
- Agriculture: Project: Agricultural resources investigations in northern Italy and southern France

**COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N. H.**
- Differences in radar return from ice-covered North Slope Lakes
- Application of LANDSAT imagery in the geological and soil investigations in the control western desert, Egypt

**COURT OF ACCOUNTS (AUSTRALIA).**
- Description of a simulation model of synthetic aperture radar systems
- Central swath mapping by a future satellite-borne ten-beam microwave scatterometer for inferring global ocean wind fields

**CORNELL UNIVERSITY PRESS.**
- Description of a simulation model of synthetic aperture radar systems

**DARTMOUTH COLL., HANOVER, N. H.**
- Mapping ultrasonic rocks by computer analysis of LANDSAT data

**DEPARTMENT OF ENVIRONMENT, OTTAWA (ONTARIO).**
- Remote sensing of coastal pollutants
- Ice sheet topography by satellite altimetry

**DEPARTMENT OF THE ENVIRONMENT, OTTAWA (ONTARIO).**
- Description of the coverage field of earth observation satellites at the earth surface.

**DU PONT DE NEMOURS (E. I.) AND CO., AIKERS, B. C.**
- NURE geochemical investigations in the eastern United States

**ECONOMIE RESEARCH AND TECHNOLOGY, INC., CONCORD, MASS.**
- Description of the application of HCMM thermal data to environmental management

**EDUCATIONAL RESOURCES INFORMATION CENTER. INC., POCOMOKE CITY, MD.**
- Guidance for application of remote sensing to environmental management: Appendix A: Sources of available remote sensor imagery

**ENVIRONMENTAL RESEARCH AND TECHNOLOGY, INC., CONCORD, MASS.**
- Description of the application of HCMM thermal data to environmental management

**ENVIRONMENTAL RESEARCH INST. OF MICHIGAN, ANN ARBOR.**
- Ice sheet topography by satellite altimetry

**FAIRCHILD IMAGING SYSTEMS, SYOSSET, N. Y.**
- Data processor (RPV)

**FERRANTI LTD., BRACKNELL (ENGLAND).**
- Study of the application of HCMM thermal data to environmental management

**GENERAL ACCOUNTING OFFICE, WASHINGTON, D. C.**
- Crop forecasting by satellite: Progress and problems

**GENERAL ELECTRIC CO., PHILADELPHIA, PA.**
- Central swath mapping by a future satellite-borne ten-beam microwave scatterometer for inferring global ocean wind fields

**GENERAL ELECTRIC CO., HUNTSVILLE, ALA.**
- Satellite imagery interpretation: Suggestions for laboratory design

**GEOPHYSICAL SURVEY, DENVER, COLO.**
- Description of the coverage field of earth observation satellites at the earth surface.

**GEOPHYSICAL SURVEY, UNIVERSITY, ALA.**
- Remote sensing of strippable coal reserves and mine inventory in part of the Warrior Coal Field in Alabama

**HOFSTRA UNIV., HEMPSTEAD, N. Y.**
- Detection and interpretation of ocean roughness variations across the Gulf Stream inferred from radar cross section observations

**HURON UNIV., TEX.**
- Linear feature selection with applications in remote sensing

**INTERNATIONAL GEOPHYSICAL YEAR, PARIS (FRANCE).**
- Multispectral data restoration study

**IPW, INC.**
- Multispectral data restoration study

**J. WILEY & SONS, INC., NEW YORK, N. Y.**
- Description of the coverage field of earth observation satellites at the earth surface.

**U.S. DEPARTMENT OF COMMERCE, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D.C.**
- Description of the coverage field of earth observation satellites at the earth surface.

**VERSUCHSANSTALT FUER LUFT- UNO RAUMFAHRT, (ONTARIO).**
- Description of the application of HCMM thermal data to environmental management

**W. B. STOKES & CO., NEW YORK, N. Y.**
- Description of the coverage field of earth observation satellites at the earth surface.

**WHALEY ENGINEERING, INC., CONCORD, MASS.**
- Description of the application of HCMM thermal data to environmental management

**Wiley-Liss, Inc.**
- Description of the coverage field of earth observation satellites at the earth surface.

**WRIGHT LAB., HOVINGTON UNIV., TEX.**
- Description of the application of HCMM thermal data to environmental management

**[NASA-CR-152124] p0262 N78-32522**
- Description of the coverage field of earth observation satellites at the earth surface.

**[NASA-CR-152124] p0262 N78-32522**
- Description of the coverage field of earth observation satellites at the earth surface.

**[NASA-CR-152124] p0262 N78-32522**
- Description of the coverage field of earth observation satellites at the earth surface.

**[NASA-CR-152124] p0262 N78-32522**
- Description of the coverage field of earth observation satellites at the earth surface.
JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.

JET PROPULSION LAB., CALIF. Inst. of Tech., Pasadena, Calif.
CORPORATE SOURCE INDEX

NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).
Remote sensing of atmospheric pollution from space
[NPL-QU-44] p0235 N78-30725

NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VA.
Ocean waves sensing. A bibliography with abstracts
[NTIS/P-78/0560/5] p0230 N78-30785
Remote sensing of the ocean. Part 1: Physical, chemical, and geological properties, volume 1. A bibliography with abstracts
[NTIS/P-78/0562/5] p0250 N78-32663
Remote sensing of the ocean. Part 1: Physical, chemical, and geological properties, volume 2. A bibliography with abstracts
[NTIS/P-78/0563/3] p0250 N78-32664
Remote sensing of the ocean. Part 2: Dynamics. A bibliography with abstracts
[NTIS/P-78/0564/1] p0251 N78-32665
Remote sensing applied to hydrology. A bibliography with abstracts
[NTIS/P-78/0792/8] p0256 N78-32666
Gulf Stream. A bibliography with abstracts
[NTIS/P-78/0844/1] p0251 N78-33700

NATIONAL WEATHER SERVICE, SILVER SPRING, MD.
[PB-283177/4] p0251 N78-33523

PAN AMERICAN UNIV., EDINBURG, TEX.
Plant canopy light absorption model with application to wheat
[AD-A054853] p0261 N78-30640

PENNYSYLVANIA STATE UNIV., UNIVERSITY PARK.
A study of the Tyrone-Mount Union lineament by remote sensing techniques and field methods
[E78-10155] p0244 N78-33505

PESSEY RADAR LTD., HAVANT (ENGLAND).
A CCD digital image store
[AD-A054853] p0261 N78-31306

PURDUE UNIV., LAFAYETTE, IND.
A parametric multiclass Bayes error estimator for the multispectral scanner spatial model performance evaluation.
[E78-10171] p0264 N78-28576
ECHO user's guide
[E78-10172] p0267 N78-28577
Forest resource information system
[E78-10173] p0231 N78-28578
Analytical techniques for the study of some parameters of multispectral scanner system for remote sensing
[E78-10200] p0233 N78-31498

RENSSELAER POLYTECHNIC INST., TROY, N. Y.
Some new map data encoding schemes
[AD-A054853] p0261 N78-30640

SCIENCE APPLICATIONS, INC., PASADENA, CALIF.
Detection and interpretation of ocean roughness variations across the Gulf Stream inferred from radar cross section observations
[PB-2799616/1] p0255 N78-31518

SOUTH DAKOTA STATE UNIV., BROOKINGS.
Photographic contrast enhancement of Landsat imagery
[PB-2799618/1] p0255 N78-31518
Application of heat-flow temperature model for remotely assessing near surface soil moisture by thermography
[PB-2799616/1] p0255 N78-31518

STANFORD UNIV., CALIF.
HCMM: Soil moisture in relation to geologic structure and lithology, Northern California
[E78-10177] p0242 N78-29533

STATE UNIV. OF NEW YORK, BUFFALO.
A photographic remote sensing system for the detection and quantification of urban tree stress
[PB-2799618/1] p0231 N78-28558

SYSTEMS AND APPLIED SCIENCES CORP., RIVERDALE, MD.
Remote sensing of rain over the ocean
CONTRACT NUMBER INDEX

Earth Resources/A Continuing Bibliography (Issue 20) JANUARY 1979

Typical Contract Number Index Listing

<table>
<thead>
<tr>
<th>CONTRACT NUMBER</th>
<th>PAGE NUMBER</th>
<th>ACCESION NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASS-20832</td>
<td>p0082</td>
<td>N78-12493</td>
</tr>
</tbody>
</table>

Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

AF-AFOSR-2937-76 p0261 N78-30640
CNES-75-322 p0257 A78-43332
DA PROJ. 647-82320-A-896 p0235 N78-28688
DAAG53-76-C-0067 p0264 A78-45687
DAAG53-76-C-0207 p0264 N78-28589
DI-14-31-0001-072A p0255 N78-31159
DI-14-34-0001-5050 p0260 N78-28558
DI-14-34-0001-6050 p0240 N78-28558
ESTEC-2661775-HP p0260 N78-30501
EY-76-C-09-0001 p0256 N78-33517
EY-76-C-15-1864 p0244 N78-33519
JPL 954697 p0244 N78-33644
NASA ORDIN N P-87583-G p0247 A78-49426
NASS-2792 p0268 N78-29535
NASS-3199 p0268 N78-33642
NASI-14173 p0264 A78-45750
NAS2-9580 p0269 N78-33506
NAS5-20749 p0233 N78-31498
NAS5-2079S p0230 A78-48006
NAS5-23822 p0244 N78-33505
NAS-23384 p0260 N78-28585
NAS-24082 p0265 N78-30748
NAS-24087 p0265 N78-30748
NAS-24188 p0266 N78-33513
NAS-24479 p0242 N78-29533
NAS-2730 p0251 N78-33896
NAST-100 p0254 A78-48087
NAST-109 p0248 A78-49457
NAST-127 p0242 N78-28706
NAST-127 p0261 N78-30635
NAST-131 p0243 N78-31493
NAST-1511 p0243 N78-31512
NAST-1511 p0244 N78-33644
NAST-2055 p0238 N78-33645
NASS-31006 p0259 A78-48007
NASS-31573 p0243 N78-31520
NASS-31768 p0236 N78-31507
NASS-31767 p0267 N78-28587
NASS-35243 p0269 N78-32519
NASS-35243 p0256 N78-32525
NAS5-32241 p0232 N78-30837
NAS5-14016 p0264 N78-28578
NAS5-14970 p0264 N78-28578
NAS-13500 p0207 N78-28577
NAS9-15200 p0234 N78-31500
NAS9-15323 p0265 N78-29424
NAS9-15326 p0231 N78-31501
NAS9-15496 p0264 N78-28578
NAS9-15496 p0264 N78-28578
NAS9-15476 p0233 N78-31498
NAS9-15543 p0234 N78-31504
NGL-15-006-112 p0232 N78-29536
<table>
<thead>
<tr>
<th>Accession Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASA-CR-157600</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-CR-157601</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-CR-157764</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-CR-157765</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-CR-15898C</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-NEWS-RELEASE-78-132</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-SP-427</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-58208</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-73280</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-75055</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-75548</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-78019</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-78173</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-78184</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79565</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79688</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79607</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79617</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79620</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79740</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79742</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79743</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79902</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TM-79935</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TP-1275</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NASA-TP-1292</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NOAA-78041207</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NOAA-78041213</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NOAA-78051201</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NPL-QU-44</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-75/413</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-75/446</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-75/447</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-75/525</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-76/0435</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-76/0468</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-76/0469</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-76/0629</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-77/0507</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-77/0532</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-77/0533</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-77/0677</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-77/0719</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-78/0560/9</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-78/0562/5</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-78/0563/3</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-78/0564/1</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-78/0792/9</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTIS/PS-78/0844/7</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTISUB/D/276-004</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTISUB/D/276-007</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>NTISUB/D/277-001</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PB-275437/8</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PB-276916/7</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PB-276928/2</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PB-278917/7</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PB-280733/6</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PB-281390/5</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PB-283177/4</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PR-287</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PSAD-78-52</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PSAD-78-58</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>PB-10139</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>QPR-1</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>QPR-2</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>R-SAG-7/78-01</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>REP-7</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>REP-70</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>REP-781031</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>REP-183</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>REP-2831-VOL-1</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>REP-2831-VOL-2</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>RSC-3458-2</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>SGC-70531-VOL-1</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>SGC-70532-VOL-2</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>TECH-MAN-SER-5</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>TR-EE-78-22</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>UCRL-79388</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>US-PATENT-APPL-SN-647072</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>US-PATENT-APPL-SN-667771</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>US-PATENT-APPL-SN-929087</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>US-PATENT-APPL-SN-945041</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>US-PATENT-CLASS-324-249</td>
<td>Report/Accession Number Index</td>
</tr>
<tr>
<td>US-PATENT-4,888,954</td>
<td>Report/Accession Number Index</td>
</tr>
</tbody>
</table>
This bibliography lists 273 reports, articles, and other documents introduced into the NASA scientific and technical information system between October 1 and December 31, 1978. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis.
PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC

NASA distributes its technical documents and bibliographic tools to ten special libraries located in the organizations listed below. Each library is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention.

- **CALIFORNIA**
  University of California, Berkeley
- **COLORADO**
  University of Colorado, Boulder
- **DISTRICT OF COLUMBIA**
  Library of Congress
- **GEORGIA**
  Georgia Institute of Technology, Atlanta
- **ILLINOIS**
  The John Crerar Library, Chicago
- **MASSACHUSETTS**
  Massachusetts Institute of Technology, Cambridge
- **MISSOURI**
  Linda Hall Library, Kansas City
- **NEW YORK**
  Columbia University, New York
- **PENNSYLVANIA**
  Carnegie Library of Pittsburgh
- **WASHINGTON**
  University of Washington, Seattle

NASA publications (those indicated by an "*" following the accession number) are also received by the following public and free libraries:

- **CALIFORNIA**
  Los Angeles Public Library
  San Diego Public Library
- **COLORADO**
  Denver Public Library
- **CONNECTICUT**
  Hartford Public Library
- **MARYLAND**
  Enoch Pratt Free Library, Baltimore
- **MASSACHUSETTS**
  Boston Public Library
- **MICHIGAN**
  Detroit Public Library
- **MINNESOTA**
  Minneapolis Public Library
- **MISSOURI**
  Kansas City Public Library
  St. Louis Public Library
- **NEW JERSEY**
  Trenton Public Library
- **NEW YORK**
  Brooklyn Public Library
  Buffalo and Erie County Public Library
  Rochester Public Library
  New York Public Library
- **OHIO**
  Akron Public Library
  Cincinnati Public Library
  Cleveland Public Library
  Dayton Public Library
  Toledo Public Library
- **OKLAHOMA**
  Oklahoma County Libraries, Oklahoma City
- **TENNESSEE**
  Memphis Public Library
- **TEXAS**
  Dallas Public Library
  Fort Worth Public Library
- **WASHINGTON**
  Seattle Public Library
- **WISCONSIN**
  Milwaukee Public Library

An extensive collection of NASA and NASA-sponsored documents and aerospace publications available to the public for reference purposes is maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, New York, 10017.

EUROPEAN

An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. By virtue of arrangements other than with NASA, the British Library Lending Division also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols "#" and "*", from: ESRO/ELDO Space Documentation Service, European Space Research Organization, 114, av. Charles de Gaulle, 92-Neuilly-sur-Seine, France.
**NASA CONTINUING BIBLIOGRAPHY SERIES**

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>TITLE</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NASA SP-7011</td>
<td>AEROSPACE MEDICINE AND BIOLOGY</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>Aviation medicine, space medicine, and space biology</td>
<td></td>
</tr>
<tr>
<td>NASA SP-7037</td>
<td>AERONAUTICAL ENGINEERING</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>Engineering, design, and operation of aircrafts and aircraft components</td>
<td></td>
</tr>
<tr>
<td>NASA SP-7039</td>
<td>NASA PATENT ABSTRACTS BIBLIOGRAPHY</td>
<td>Semiannually</td>
</tr>
<tr>
<td></td>
<td>NASA patents and applications for patent</td>
<td></td>
</tr>
<tr>
<td>NASA SP-7041</td>
<td>EARTH RESOURCES</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Remote sensing of earth resources by aircrafts and spacecraft</td>
<td></td>
</tr>
<tr>
<td>NASA SP-7043</td>
<td>ENERGY</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Energy sources, solar energy, energy conversion, transport, and storage</td>
<td></td>
</tr>
<tr>
<td>NASA SP-7500</td>
<td>MANAGEMENT</td>
<td>Annually</td>
</tr>
<tr>
<td></td>
<td>Program, contract, and personnel management, and management techniques</td>
<td></td>
</tr>
</tbody>
</table>

Details on the availability of these publications may be obtained from:

**SCIENTIFIC AND TECHNICAL INFORMATION OFFICE**

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

Washington, D.C. 20546