United States Department of the Interior
Earth Resources Observation Systems Program

How to Get Started in Remote Sensing

by
Priscilla A. Woodward

This paper is prepared for the person who has heard of remote sensing, who intuitively feels it might benefit his activities, and knows little else on the subject. It is an attempt to suggest ways and means of getting information and guidance, and to clarify some of the jargon.

June 1971
ERRATA SHEET

for

HOW TO GET STARTED IN REMOTE SENSING
(Preliminary Revised)
June 1971

by
Priscilla A. Woodward

Page 6
Correction

Page 8
Correction
Annual Subscription $52.50
Delete .............
Mr. Eric Tietz

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Prof. Thomas R. Lyons

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20. West Virginia University
Morgantown, West Virginia

Page 14
Correction
Raytheon/Autometrics
Waltham, Massachusetts

Page 16
Delete .............
Comprehensive services are offered by many aerial survey companies such as:

Remote Sensing Inc.
Houston, Texas
HOW TO GET STARTED IN REMOTE SENSING

Introduction

Remote sensing is the measurement of some property of an object without having the measuring device physically in contact with the object. Everything absorbs, emits, scatters, transmits or reflects electromagnetic energy (radiation). Remote sensors of the electromagnetic spectrum measure radiation, both emitted and reflected. Knowing the values of reflectivity and emissivity of different objects within the spectral regions, such as gamma ray, x-ray, ultraviolet, visible, infrared, and microwave, one can predict the appearance of these objects of detected radiation. And knowing the spectral characteristics of the object to be measured, one can pick the remote sensing device that will give the greatest discrimination. The readout of the sensors can be charts of radiation levels from discrete areas (absolute measurements) or maplike presentations (relative measurements). An early form, and still the most useful form of remote sensing is photography, which is interpreted by recognition of the shape, size, and position of objects. This method is used within the visible and near infrared regions of the spectrum and has been extended to microwave by the use of radar. Identification and interpretation is also possible by recognition of temporal change in objects. This method requires comparison of photographs obtained repetitively and is useful from the ultraviolet through the infrared. Figure 1 relates some of the sensor devices to the wavelength and frequency regimes of the electromagnetic spectrum, and Figure 2 summarizes types of information that may be interpreted from observations of various parts of the spectrum.
FIGURE 1. Sensors as they relate to wavelength and frequency of the electromagnetic spectrum

- **GAMMA RAYS**
  - Scintillation counters; gamma ray spectrometers

- **X RAYS**
  - Scanners with filtered photomultipliers; image orthicon and cameras with filtered infrared film $> 2500 \text{ Å}$

- **UV**
  - Film in cameras

- **VISIBLE**
  - Solid state detectors in scanners and radiometers

- **INFRARED**
  - Medium and far
  - Infrared sensitive film in cameras

- **MICROWAVE**
  - Radar; rf receivers in imagers and radiometers

- **Electromagnetic pulse techniques**
FIGURE 2. Summary of types of information and/or properties of materials that may be interpreted from observations of various parts of the electromagnetic spectrum.
Sources of Bibliographic Help

To effectively use remote sensing there must be some understanding of the theory, techniques and instrumentation used in this field. Thus far there is no comprehensive textbook devoted to the subject and so instead we present a short bibliography of general interest. This bibliography is in no way complete.


Kaltenbach, J. L., comp., 1970, Apollo Multispectral Photographic Information: NASA Technical Memorandum, NASA TM X-1957. (Includes papers by Colwell on rationale for selecting certain spectral bands for Earth Resources Survey Program; by Lowman on background information on Experiment S0 65; and by Yost and Wenderoth on color additive techniques)


Michigan University, Institute of Science and Technology, Willow Run Laboratories, 1968, The University of Michigan Notes for a Program of Study in Remote Sensing of Earth Resources, 2d. ed.: NASA, Manned Spacecraft Center, Houston, Tex.


National Aeronautics and Space Administration, Office of Technology Utilization, 1970, Remote Sensing of Earth Resources - a literature survey with indexes, 1221 p. (This bibliography is available for $10.00 from NTIS and is identified by accession no. N70-41047)


There are several places that collect the current materials related to remote sensing of earth resources for the benefit of anyone interested. They are:

EROS Program Library
Rm. 1109 801-19th Street, N.W.
Washington, D.C. 20242
Tel. (202) 343-7500

This library holds copies of reports generated by EROS Program activities and general references on the subject of remote sensing of earth resources. Materials may be borrowed from this Library or used there.

Technology Application Center
University of New Mexico
Albuquerque, New Mexico 87106
Tel. (505) 277-3118, 3111

While not a library in a strict sense, the center does provide bibliographic service. It is a NASA Regional Dissemination Center. This means that they have access to all reports produced and collected by NASA in
support of its mission, except the raw data collected as part of NASA's Earth Resources Aircraft Program. In addition, the center has expanded its search for more complete coverage of reports on remote sensing by looking at several other significant abstract journals. From all these sources they have prepared a bibliography on Remote Sensing, in 3 volumes, costing $125.00 each, representing the period from 1962 to the present. They intend to update this work annually. In most cases they can provide microfiche or hard copy of the included reports at cost. The center will also provide a variety of bibliographic services, including individual searches. The center also sells Gemini and Apollo photographs. Price lists for the photographs and the variety of bibliographic services are available upon request.

Earth Resources Research Data Facility
NASA, Manned Spacecraft Center
Houston, Texas 77058
Tel. (713) 483-7681

This library is devoted to reports, photos, and magnetic tapes repre-senting the raw data and the reports produced as a result of the NASA Earth Resources Aircraft Program. Their collection is available for use at the facility, but not through loan. Special arrangements for repro-duction of their holdings can be made for anyone interested in evaluating the data. (See Participation in U.S. Government Investigations.)

National Technical Information Service
Springfield, Virginia 22151
Tel. (703) 321-8543 Sales
(703) 321-8523 Bibliographic information services
(703) 321-8888 General information on NTIS

NTIS is a distribution center for reports prepared with Federal funds.
They prepare a biweekly abstract journal of their new accessions, Government Reports Announcements, that gives information necessary for ordering the reports; annual subscription $30.00. Reports are now available in hard copy: 1-300 pages, $3.00; 301-600 pages, $6.00; 601-900 pages, $9.00; or microfiche, $0.95. The material available is extensive, but not complete.

A brochure describing all of the services available can be obtained by writing:

Mr. Eric Tietz
Assistant to the Director
National Technical Information Service
Springfield, Virginia 22151
Schools and Colleges Interested in Remote Sensing and Photointerpretation

The following list is an amended version of one compiled by the American Society of Photogrammetry. Specific information on possible courses can be obtained by writing to the schools listed.

1. The University of Michigan
   Ann Arbor, Michigan
   Prof. Charles E. Olson
   1046 Natural Resources Bldg.
   University of Michigan
   Ann Arbor, Michigan 48104
   Miss Virginia Prentice
   Inst. of Science & Technology
   The University of Michigan
   P. O. Box 618
   Ann Arbor, Michigan 48107

2. Syracuse University
   Syracuse, New York
   Prof. Bruce T. Stanton
   Department of Forest Management
   State University
   Syracuse, New York 13210
   Prof. Robert H. Brock, Jr.
   321 Bray Hall
   College of Forestry
   State University
   Syracuse, New York 13210

3. Cornell University
   Ithaca, New York
   Dr. Donald J. Belcher
   Cornell Aeronautical Laboratory
   Cornell University
   Ithaca, New York 14850
   Prof. Arthur J. McNair
   School of Civil Engineering
   Hollister Hall
   Cornell University
   Ithaca, New York 14850

4. The University of Wisconsin
   Madison, Wisconsin
   Prof. James P. Scherz
   The University of Wisconsin
   Madison, Wisconsin 53706
5. Permian Basin Graduate Center
   Midland, Texas

6. Texas A&M University
   College Station, Texas

7. Stephen F. Austin State University
   Nacogdoches, Texas

8. The University of New Mexico
   Albuquerque, New Mexico

9. University of Arizona
   Tucson, Arizona

10. Stanford University
    Stanford, California

11. University of California
    Berkeley, California

12. University of Florida
    Gainesville, Florida

Mrs. Patricia M. Beck
Administrative Assistant
Permian Basin Graduate Center
P. O. Box 1518
Midland, Texas 79701

Prof. Robert D. Turpin
Civil Engineering Department
Texas A&M University
College Station, Texas 77843

Prof. Robert D. Baker
Forestry Department
Stephen F. Austin State University
Nacogdoches, Texas 75961

Prof. Thomas R. Lyons
Technology Application Center
The University of New Mexico
Albuquerque, New Mexico 87106

Prof. Philip B. Newlin
Civil Engineering Department
University of Arizona
Tucson, Arizona 85721

Prof. Ronald J. P. Lyon
School of Earth Sciences
Stanford University
Stanford, California 94305

Prof. E. I. Rich
School of Earth Sciences
Stanford University
Stanford, California 94305

Prof. Robert N. Colwell
School of Forestry
University of California
Berkeley, California 94720

Prof. Francis H. Moffitt
Civil Engineering Dept.
University of California
Berkeley, California 94720

Prof. Byron E. Ruth
Dept. of Civil Engineering
University of Florida
Gainesville, Florida
13. Florida Atlantic University
Boca Raton, Florida

Prof. James P. Latham
Professor of Geography
Florida Atlantic University
Boca Raton, Florida 33432

Prof. William Kuyper
Florida Atlantic University
Boca Raton, Florida 33432

14. University of Georgia
Athens, Georgia

Prof. Donald W. Maxfield
Dept. of Geography
University of Georgia
Athens, Georgia 30601

15. Louisiana State University
Baton Rouge, Louisiana

Dr. J. R. Van Lopik
Coastal Studies Building
Louisiana State University
Baton Rouge, Louisiana 70803

Prof. Robert G. Reeves
Dept. of Geology
Colorado School of Mines
Golden, Colorado 80401

16. Colorado School of Mines
Golden, Colorado

Mr. R. D. Higgins, Manager
Training in Business & Industry
Humber College of Applied Arts & Technology
Rexdale, Ontario, Canada

17. Humber College of Applied Arts & Technology
Rexdale, Ontario, Canada

Prof. Antonio M. Aguilar
Civil Engineering Department
Kansas State University
Manhattan, Kansas 66502

18. Kansas State University
Manhattan, Kansas

Prof. Robert D. Miles
Purdue University
Lafayette, Indiana 47907

19. Purdue University
Lafayette, Indiana

Prof. Edward M. Mikhail
Civil Engineering Dept.
Purdue University
Lafayette, Indiana 47907

20. West Virginia University
Morgantown, West Virginia

Prof. Don Kulow
c/o U.S. Geological Survey
801 - 19th Street, NW, Room 1032
Washington, D.C. 20242
21. Pennsylvania State University
   University Park, Pennsylvania
   Prof. Harmer A. Weeden
   Dept. of Civil Engineering
   Pennsylvania State University
   University Park, Pennsylvania 16802

22. University of Washington
    Seattle, Washington
    Prof. J. E. Colcord, Jr.
    Dept. of Civil Engineering
    More Hall
    University of Washington
    Seattle, Washington 98104

23. University of Kansas
    Lawrence, Kansas
    Center for Research, Inc.
    University of Kansas
    Lawrence, Kansas 66044

24. Ohio State University
    Columbus, Ohio
    Prof. Olin W. Mintzer III
    Ohio State University
    2036 Neil Avenue
    Columbus, Ohio
    Prof. Dean C. Merchant
    Dept. of Geodetic Science
    Ohio State University
    164 West 19th Avenue
    Columbus, Ohio 43210
    Dr. Sanjib K. Ghosh
    Dept. of Geodetic Science
    Ohio State University
    Columbus, Ohio 43210

25. University of Minnesota
    Minneapolis, Minnesota
    Prof. Jesse E. Fant
    123 Main Engineering Bldg.
    University of Minnesota
    Minneapolis, Minnesota

26. University of Connecticut
    Storrs, Connecticut
    Prof. Mitchell D. Ferrill
    Forestry & Wildlife Mgmt.
    University of Connecticut
    Storrs, Connecticut 06268

27. University of Illinois
    Urbana, Illinois
    Dr. Ing. Houssam M. Karara
    Dept. of Civil Engineering
    University of Illinois
    Urbana, Illinois
    Prof. Nelson R. Nunnally
    Dept. of Geography
    University of Illinois
    Urbana, Illinois
<table>
<thead>
<tr>
<th>No.</th>
<th>Institution</th>
<th>Address</th>
<th>Contact Person</th>
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</thead>
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<tr>
<td>28.</td>
<td>Auburn University</td>
<td>Auburn, Alabama</td>
<td>Prof. William G.G. Blakney</td>
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<td></td>
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<td>Auburn University, Civil Eng. Dept.</td>
<td>Auburn, Alabama</td>
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<td>29.</td>
<td>University of Maine</td>
<td>Orono, Maine</td>
<td>Dr. Harold E. Young</td>
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<td>Orono, Maine 04473</td>
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<td>30.</td>
<td>Oregon State University</td>
<td>Corvallis, Oregon</td>
<td>Prof. Robert J. Schultz</td>
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<td>Oregon State University</td>
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<td>Corvallis, Oregon</td>
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<td>31.</td>
<td>North Carolina State University</td>
<td>Raleigh, North Carolina</td>
<td>Dr. J.O. Lammi</td>
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<td>State College Station</td>
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<td>Raleigh, North Carolina 27607</td>
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<td>Northern Arizona University</td>
<td>Flagstaff, Arizona 86001</td>
<td>Prof. Thomas E. Avery</td>
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<td>School of Forestry</td>
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<td>Dr. Victor I. Myers</td>
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<td>East Tennessee State University</td>
<td>Johnson City, Tennessee</td>
<td>Dr. Robert W. Peplies</td>
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<td>Johnson City, Tennessee 37601</td>
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<td>35.</td>
<td>University of Iowa</td>
<td>Iowa City, Iowa</td>
<td>Dr. Frank Horton</td>
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<td>Iowa City, Iowa 52240</td>
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<td>36.</td>
<td>Northwestern University</td>
<td>Evanston, Illinois</td>
<td>Dr. Duane F. Marble or Dr. Eric Moore</td>
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<td>Department of Geography</td>
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<td>Evanston, Illinois 60201</td>
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<td>37.</td>
<td>University of California</td>
<td>Riverside, California</td>
<td>Dr. Leonard W. Bowden</td>
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<td>Department of Geography</td>
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<td>University of California (Riverside)</td>
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<td>Riverside, California 92502</td>
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Sources of Information and Expertise in Various Remote Sensing Fields

The development of the field of remote sensing has inevitably lead to specialization. It would be very difficult to cover every aspect, every institution, or every individual who has expertise of value to potential users. There are offices in NASA, Departments of the Interior, Agriculture, Commerce, and Navy, too numerous to mention. The following are those outside the government we have knowledge of at the present time. We can not guarantee the accuracy or completeness of this list, nor does this in any way represent an endorsement by the government of any group listed.

Radar technology:

Conductron Corp.
Ann Arbor, Michigan

Dartmouth College
Hanover, New Hampshire

Goodyear Aerospace
Litchfield Park, Arizona

Grumman Aerospace Corporation
Bethpage, New York

North American Rockwell
Autonetics Division
Los Angeles, California

Raytheon/Autometrics
Alexandria, Virginia

University of Kansas
Center for Research (CRES)
Lawrence, Kansas

University of Michigan, Willow Run Labs.
Ann Arbor, Michigan

Westinghouse Electric Corp.
Baltimore, Maryland

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Microwave technology:
Aerojet-General Corp., Space Division
El Monte, California
Ewen Knight Corporation
East Natick, Massachusetts
Raytheon Corporation
Burlington, Massachusetts

Infrared technology:
Bendix Corporation
Ann Arbor, Michigan
Daedalus Enterprises, Inc.
Ann Arbor, Michigan
HRB-Singer, Inc.
State College, Pennsylvania
North American Rockwell, Space Division
Downey, California
Stanford University, Remote Sensing Lab.
Stanford, California
Texas Instruments
Dallas, Texas
University of Michigan, Willow Run Labs.
Ann Arbor, Michigan

Multispectral Scanning:
Bendix Corp., Aerospace Systems Division
Ann Arbor, Michigan
Daedalus Enterprises, Inc.
Ann Arbor, Michigan
Hughes Aircraft, Space Systems Division
El Segundo, California
HRB-Singer, Inc.
State College, Pennsylvania
South Dakota State University, Remote Sensing Institute, Brookings, South Dakota
Texas Instruments
Dallas, Texas
University of Michigan, Willow Run Labs.
Ann Arbor, Michigan
Multispectral Photography:

International Imaging Systems (I²S)
Mountain View, California

Itek Corporation
Arlington, Virginia

South Dakota State University
Remote Sensing Institute
Brookings, South Dakota

University of Arizona, Optical Sciences
Tucson, Arizona

Data Processing

density slicing--

International Imaging Systems (I²S)
Mountain View, California

Philco-Ford Corp., Space & Re-entry Systems Division
Palo Alto, California

Spatial Data Systems
Goleta, California

automatic photo-
interpretation--

Bausch & Lomb
Rochester, New York

University of Kansas, CRES
Lawrence, Kansas

Purdue University, Laboratory for Applications in Remote Sensing
Lafayette, Indiana

Resources Technology, Inc.
Houston, Texas

South Dakota State University
Remote Sensing Institute
Brookings, South Dakota

University of Michigan, Willow Run Labs.
Ann Arbor, Michigan

Comprehensive services are offered by many aerial survey companies such as:

Remote Sensing, Inc.
Houston, Texas
A good source of information on these companies is *Photogrammetric Engineering*, a monthly publication of the American Society of Photogrammetry.
Participation in U.S. Government Investigations

The National Aeronautics and Space Administration is responsible for the development of space technology for the Federal government. To fulfill this mission they supervise the design and flights of experimental satellites and encourage the development of operational programs using space data. Experimental satellites, one of which will be ERTS-A, carry a variety of instruments. These are described, as are the methods for proposing experiments using this equipment, in NASA Handbook 8030.1A, Apr. 1967, Opportunities for Participation in Spaceflight Investigations, available from the Supt. of Documents, U.S. Government Printing Office, Washington, D.C. 20402 for $1.00. Memorandum change 28, June 2, 1970, relates to Earth Resources Technology Satellite (ERTS A & B).

Prior to the launch of ERTS-A, the primary source of remotely sensed earth resources data is from the Aircraft Program, a part of the NASA, Earth Resources Program. This program is described in Earth Resources Program Synopsis of Activity, published by NASA, Manned Spacecraft Center, Houston, Texas, in March 1970. In order to encourage participation in this program and to gain the maximum benefit from the aircraft data, NASA has created a system whereby private citizens, private institutions, or government officials can receive raw data collected in the Aircraft Program. Further information about this may be obtained by writing to Edward Zeitler, Earth Resources Research Data Facility, MSC, Houston, Texas, or Dr. Arch Park, Chief, NASA, Earth Resources Survey, Washington, D.C. The Earth Resources Research Data Facility holds the raw data and appropriate catalogs of the data.
The Department of the Interior through the Geological Survey will consider proposals for experimental work. Information on the preparation of proposals can be obtained by writing to the U.S. Geological Survey, Branch of Contracts, Room 1312 Interior Building, Washington, D.C. 20242 and requesting a copy of *Instructions for the Preparation of Proposals* or *Instructions for Preparation of Research Proposals from Non-Profit Educational Institutions and Non-Profit Organizations*, whichever is appropriate.
## Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
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<tbody>
<tr>
<td>Å</td>
<td>Angstrom, a unit of measure of wavelength</td>
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<td>A/C</td>
<td>Aircraft</td>
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<td>AFCRL</td>
<td>Air Force Cambridge Research Laboratory</td>
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<td>AIAA</td>
<td>American Institute of Aeronautics and Astronautics</td>
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<tr>
<td>Apollo</td>
<td>The current series of manned spaceflights</td>
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<td>ASP</td>
<td>American Society of Photogrammetry, headquarters in Falls Church, Virginia</td>
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<tr>
<td>ATS</td>
<td>Applications Technology Satellite</td>
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<tr>
<td>BCF</td>
<td>Bureau of Commercial Fisheries, a bureau of Dept. of the Interior until Oct. 31, 1970 when it became a part of NOAA</td>
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<tr>
<td>BIA</td>
<td>Bureau of Indian Affairs, a bureau of Dept. of the Interior</td>
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<tr>
<td>BLM</td>
<td>Bureau of Land Management, a bureau of Dept. of the Interior</td>
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<td>BM</td>
<td>Bureau of Mines, a bureau of Dept. of the Interior</td>
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<td>BOR</td>
<td>Bureau of Outdoor Recreation, a bureau of Dept. of the Interior</td>
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<td>BR</td>
<td>Bureau of Reclamation, a bureau of Dept. of the Interior</td>
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<td>BSW</td>
<td>Bureau of Sports Fisheries and Wildlife, a bureau of Dept. of the Interior</td>
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<tr>
<td>CEP</td>
<td>Color Ektachrome</td>
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<td>CEQ</td>
<td>Council on Environmental Quality, in the Executive Office of the President</td>
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<tr>
<td>CFSTI</td>
<td>Clearinghouse for Federal Scientific and Technical Information. As of September 2, 1970 known as NTIS.</td>
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<tr>
<td>CIR</td>
<td>Color Infrared</td>
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<tr>
<td>COSPEAR</td>
<td>Committee on Space Programs for Earth Observations - Advisory committee of NAS/NRC to advise Dept. of the Interior on space programs</td>
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<td>CRES</td>
<td>Center for Research, Inc., of the University of Kansas</td>
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CRREL  Cold Regions Research and Engineering Laboratory of U.S. Army
CRT    Cathode ray tube
DDS    Data Distribution System
EM     Electromagnetic (spectrum)
EOS    Earth Observatory Satellite, a proposed satellite
EPA    Environmental Protection Agency
EROS   Earth Resources Observation Systems, a program of the Dept. of the Interior
ERRDF  Earth Resources Research Data Facility, at MSC, Houston, Texas
ERS    Earth Resources Satellite, a proposed satellite
ERTS-A,B Earth Resources Technology Satellite, "A" represents the first of the series of experimental satellites with Earth orientation, "B" the second to follow 1 year later
ESSA   Environmental Sciences Services Administration, an agency of the Dept. of Commerce
GDHS   Ground data handling system
Gemini The series of manned spaceflights preceding Apollo
GOES   Geostationary Operational Environmental Satellite
GSFC   Goddard Space Flight Center, a facility of NASA at Greenbelt, Maryland
HDRRS  High Data Rate Relay Satellite, a proposed communication satellite
HRIR   High Resolution Infrared Radiometer, an instrument in the Nimbus satellite
IEEE   Institute of Electrical and Electronics Engineers
IR     Infrared
ITOS   Improved Tiros Operational Satellite
JPL    Jet Propulsion Laboratory, administered by California Institute of Technology
LARS   Laboratory for Applications in Remote Sensing, a facility of Purdue University
<table>
<thead>
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<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>MRIR</td>
<td>Medium Resolution Infrared Radiometer, used in the Nimbus project</td>
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<td>MSC</td>
<td>Manned Spacecraft Center, a facility of NASA at Houston, Texas devoted to man in space programs</td>
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<tr>
<td>MSS</td>
<td>Multi-Spectral Scanner; part of the instrument package to be carried on ERTS-A</td>
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<tr>
<td>NAS</td>
<td>National Academy of Science</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration, the Federal agency charged with development of space programs</td>
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<tr>
<td>NASC</td>
<td>National Aeronautics and Space Council, in the Executive Office of the President</td>
</tr>
<tr>
<td>NAVOCEANO</td>
<td>U.S. Navy Oceanographic Office</td>
</tr>
<tr>
<td>Nimbus</td>
<td>A series of experimental meteorological satellites</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanographic and Atmospheric Administration</td>
</tr>
<tr>
<td>NPS</td>
<td>National Park Service, a bureau of Dept. of the Interior</td>
</tr>
<tr>
<td>NRC</td>
<td>National Research Council</td>
</tr>
<tr>
<td>NSDPF</td>
<td>National Space Data Processing Facility, located at Goddard Space Flight Center, Greenbelt, Maryland</td>
</tr>
<tr>
<td>NTIS</td>
<td>National Technical Information Service, operated by Dept. of Commerce; formerly CFSTI</td>
</tr>
<tr>
<td>OSSA</td>
<td>Office of Space Sciences and Applications, a part of NASA</td>
</tr>
<tr>
<td>OST</td>
<td>Office of Science and Technology, in the Executive Office of the President</td>
</tr>
<tr>
<td>RBV</td>
<td>Return Beam Vidicon; part of the instrument package to be carried on ERTS-A</td>
</tr>
<tr>
<td>rf</td>
<td>Radio Frequency</td>
</tr>
<tr>
<td>S/C</td>
<td>Spacecraft</td>
</tr>
<tr>
<td>Skylab-A</td>
<td>Manned experimental laboratory in Earth orbit - &quot;A&quot; represents first of the series</td>
</tr>
<tr>
<td>SLAR</td>
<td>Side Looking Airborne Radar</td>
</tr>
<tr>
<td>SLR</td>
<td>Side Looking Radar</td>
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</table>
Synchronous Meteorological Satellite, to be launched in 1973

Spacecraft Oceanography project of NAVOCEANO

Technology Application Center of the Univ. of New Mexico - serves as a NASA Regional Dissemination Center

Training for Environmental Resources Remote Sensing Applications, a program of the University of Michigan

Television Infrared Operational Satellite

U. S. Department of Agriculture

U. S. Geological Survey, a bureau of Dept. of the Interior

Ultraviolet, a part of the electromagnetic spectrum from about 100 Å to 4000 Å wavelength

Waterways Experiment Station, Vicksburg, Mississippi, a part of Army, Corps of Engineers

Woods Hole Oceanographic Institute

λ Lambda, the Greek letter representing wavelength

μ Symbol for micron, a unit of measure of wavelength

*This publication is also available in Spanish.