ERTS

EARTH RESOURCES TECHNOLOGY SATELLITE

"We are just beginning to comprehend the benefits that space technology can yield here on earth, and the potential is enormous."

President Richard M. Nixon

EARTH RESOURCES INVENTORY

Water, vegetation and soils all have unique signatures in the realm of multispectral light, and there is evidence they will reveal their identity from images produced through the technique of remote sensing. Results of earth surveys from high-altitude aircraft have already aided scientists and conservationists in charting the features of the earth. Synoptic images returned on a repetitive schedule from the vantage point of an earth-orbiting satellite hold even greater promise of charting the earth and its bounty.

NASA has included earth resources experiments on the testing agenda of several Gemini and Apollo manned spacecraft flights. Images were made of the earth both in the visible light range and in the unseen infrared and ultraviolet. Results were promising and indicated that such data properly interpreted may someday assist in increasing agricultural yield, chart the movement of sea life, monitor concentrations of air and water pollution, and furnish more knowledge of geography, cartography, and hydrology. A summary of a few experiments indicates the potential of earth surveys from satellites:

AGRICULTURE

- Wheat fields have been identified on images returned by Apollo 6.
- Infrared photos from high-altitude aircraft have shown difference between a healthy cotton crop compared with a unhealthy yield.

FORESTRY

- Extensive flood damage over 165 square miles along the Ouachitra River in Louisiana following a storm in January, 1969, was shown in Apollo 9 images.
- Infrared imagery from Apollo experiments have indicated potential in the detection of forest fires.

HYDROLOGY

- Gemini 4 provided pictures of water drainage patterns in Western Texas.
- Apollo 9 photos showed snow concentrations on an Arizona mountain range.

CARTOGRAPHY

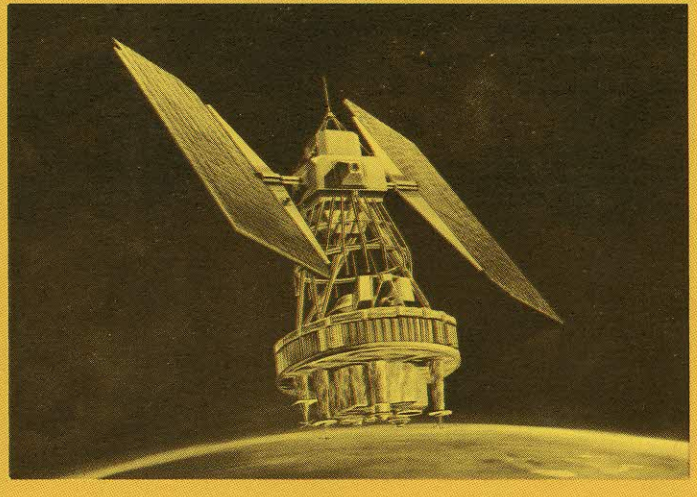
- Comparison photos taken of Cape Kennedy area by Gemini 6 and Gemini 7 revealed changes in urban structure and the addition of new roads in the intervening six months between flights.

EARTH RESOURCES SATELLITE SYSTEM

NASA is currently developing two experimental Earth Resources Technology Satellites (ERTS A/B); the first to be launched in 1972 and the second during the following year. The Earth Resources Technology Satellite program is a first step in the merger of space and remote sensing technologies into a system devoted to developing the ability for more efficient management of the earth's resources.

Design of the observatory is based on the highly successful Nimbus meteorological satellites which have regularly returned pictures of the earth's weather state since 1964. The ERTS observatory will operate in a polar orbit, 500 miles above the earth, and return images from two independently functioning multispectral sensors. A Data Collection System on board the observatory will gather environmental information from earth-based platforms and relay this data to the ground processing facility.

Operation of the observatory will be controlled by the Ground Data Handling System facility to be located at NASA/Goddard Space Flight Center. The GDHS will also process the wideband video data into both black and white, and color photo images tailored to the needs of the ERTS users.



ERTS CONTRACTOR TEAM

The General Electric Company Space Division is the prime contractor to NASA's Goddard Space Flight Center for the ERTS program. Bendix Corporation and Wolf Research and Development are major subcontractors for the data processing facility. Radiation Inc. will provide the Data Collection System.

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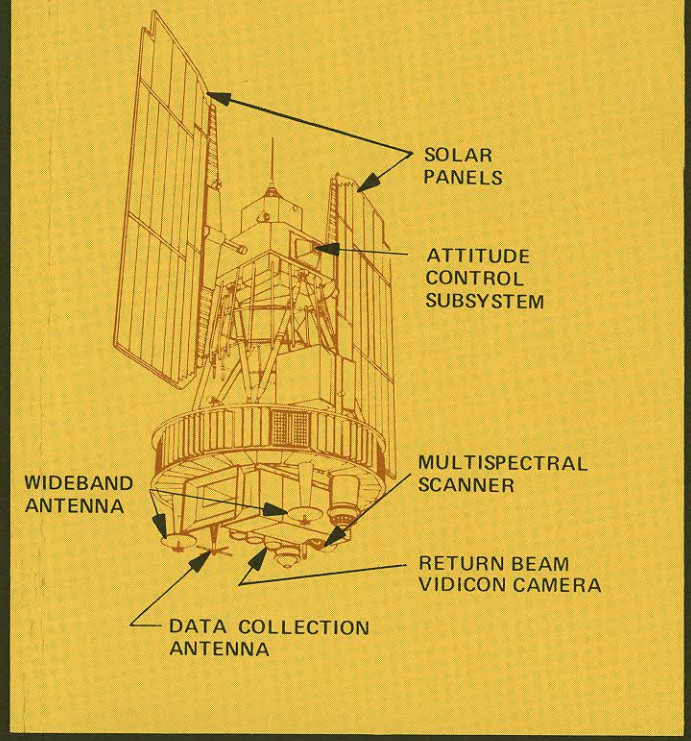
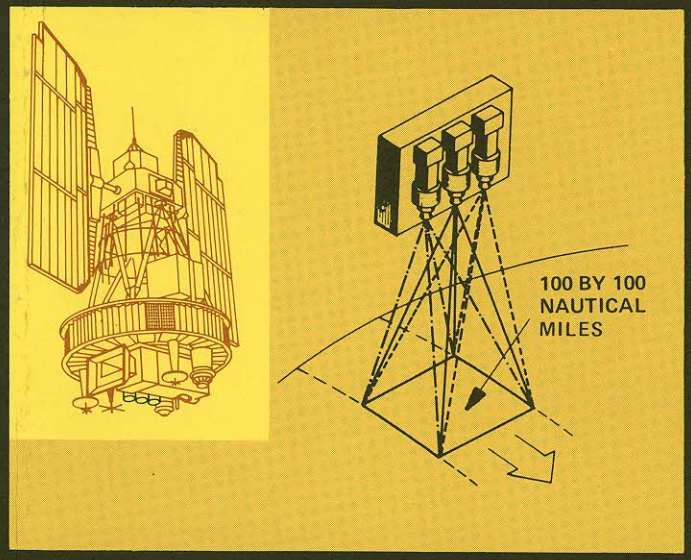
Observatory The observatory will carry a Return Beam Vidicon (RBV) camera subsystem and a Multispectral Scanner (MSS) which will furnish independent views of the earth directly beneath the satellite to data acquisition stations on the ground. Two wideband video tape recorders on board the observatory will store up to 30 minutes of picture information for delayed readout. The observatory will also serve as a relay for collecting data from remotely located ground platforms (part of the Data Collection System).

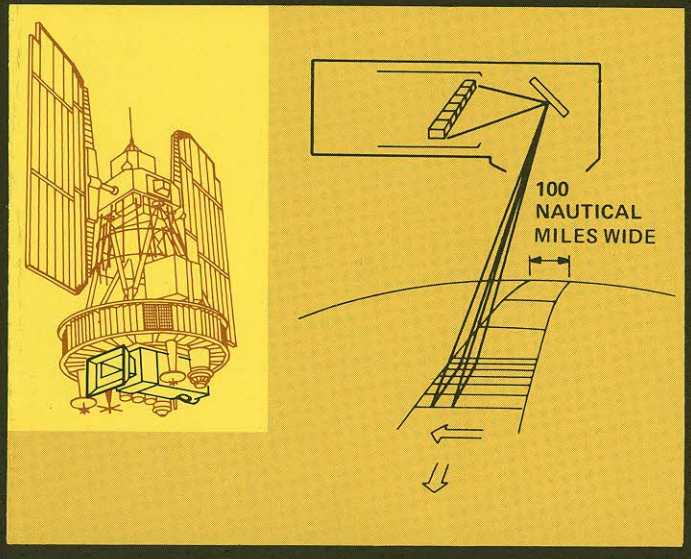
The observatory will make 14 revolutions each day. Ground coverage will proceed westward until global coverage is completed in 18 days. An active attitude control subsystem will maintain the observatory within ±0.7 degree of the local vertical. Two solar panels will track the sun and provide 500 watts of electrical energy to power the spacecraft.



Return Beam Vidicon Subsystem Three RBV cameras will view the same 100 mile square ground scene from the ERTS observatory, but they will be sensitive to different spectral bands within the total band from 0.48 to 0.83 microns. When the cameras are shuttered, images will be stored on photosensitive surfaces within each vidicon camera tube, then scanned to produce video outputs. The cameras will be scanned in sequence requiring about 3.5 seconds to read out each of the three images. To produce overlapping images of the ground along the direction of satellite motion, the cameras will be reshuttered every 25 seconds.



Multispectral Scanner Subsystem The MSS will collect data by continually scanning the ground directly beneath the observatory. The width of the strip will be identical to the coverage by the RBV, 100 nautical miles. Optical energy will be sensed by an array of detectors simultaneously in four spectral bands (from 0.5 to 1.1 microns) on ERTS A, and an added fifth band (from 10.4 to 12.6 microns) for ERTS B. During ground processing, 100-by-100 nautical-mile frames will be constructed from the continuous strip to correspond with the RBV information.



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Data Collection System The DCS will obtain data from remote, automatic data collection platforms (to be located in the United States and its coastal areas) and relay the information to ground stations via the ERTS spacecraft. Each DCS platform will collect data from as many as eight sensors which sample such local environmental conditions as stream flow, snow depth, or soil moisture. Data from any platform will be available to users in less than 12 hours from the time the sensor measurements are made.

Payload and Telemetry Data Handling RBV and MSS data will be transmitted to the tracking stations via dual wideband (20 MHz) S-Band data links where it will be recorded on magnetic tape. These tapes will be shipped daily to the Ground Data Handling System (GDHS).

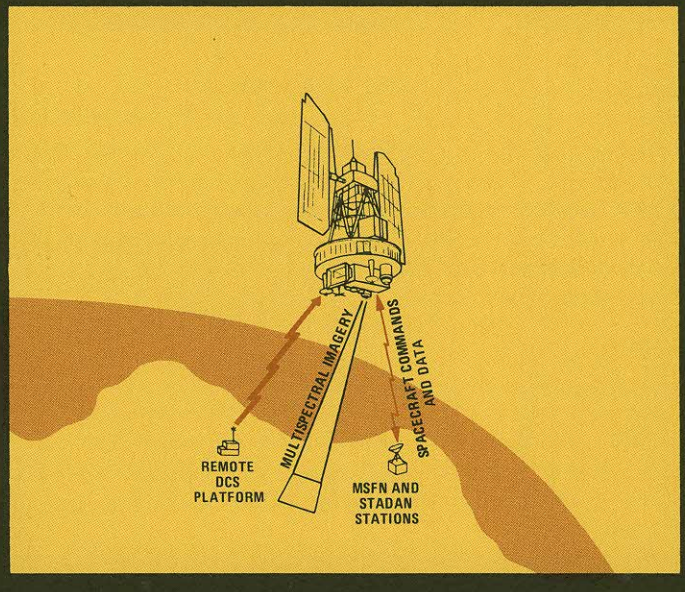
Narrowband telemetry will provide for satellite housekeeping, the relay of DCS data and such payload related data as attitude and timing information.

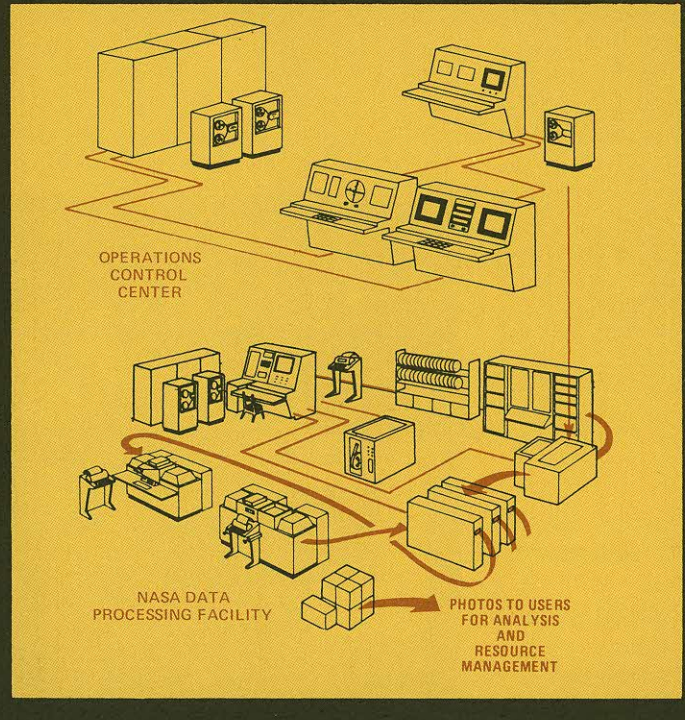
The onboard satellite telemetry, tracking and command subsystem will be compatible with tracking stations in either NASA's Manned Space Flight Network (MSFN) or the Space Tracking and Data Acquisition Network (STADAN). Payload data will be received at one of three sites located in Alaska; Goldstone, California; or the Goddard Space Flight Center in Maryland.

Ground Data Handling System The Ground Data Handling System (GDHS) will be located at the NASA/Goddard Space Flight Center in Greenbelt, Maryland. It will include an Operations Control Center (OCC) and the NASA Data Processing Facility (NDPF). The NDPF includes a display area where users may have access to data from the ERTS observatory.

Command of the observatory and payload functions will be controlled from the Operations Control Center. Trend analysis and mission planning will also be performed at the OCC.

NASA Data Processing Facility will receive, process, store and distribute copies of all data collected from the multispectral sensors in the form of high-quality film images, digitized data on computer-readable magnetic tape, and DCS information in the form of digitized data. User's requests for ERTS products will be filled by the NDPF on a job-oriented production cycle.





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ERTS PRODUCTS AND USER SERVICES

It is anticipated that close to ½-million master images will be processed and stored at the NASA Data Processing Facility (NDPF) each year. The storage and retrieval system will aid the user in selecting only those images that will be of significance to him. For example, the user will be able to specify copies of images of selected land areas taken at particular times of the year. Functions to be performed within the NDPF include:

CONVERSION

- Bulk Processed - All images will be corrected for geometric and radiometric errors and printed in black and white. Twenty percent of bulk processed images will be printed in color.
- Precision Processed - Film master images of RBV and MSS frames selected by the user can be further corrected and transformed into selected map coordinates and precisely annotated with ground location tick marks.
- Special Processed - Computer-readable tape records will be made from a selection of bulk and precision processed images.

WORKING STORAGE

All data at the NDPF will be logged and maintained in active storage for efficient access on a user's request.

USER SERVICES

Users will have access to all NDPF data through several files to provide efficiency in searching areas of interest. Some of these aids are:

- Browse Files - Complete microfilm file of all images arranged by date and location.
- Coverage Catalog - Listing of U.S. images that are returned over an 18-day orbit cycle. This catalog will be updated on a regular schedule.
- DCS Catalog - Listing of information available from the remote earth platforms.

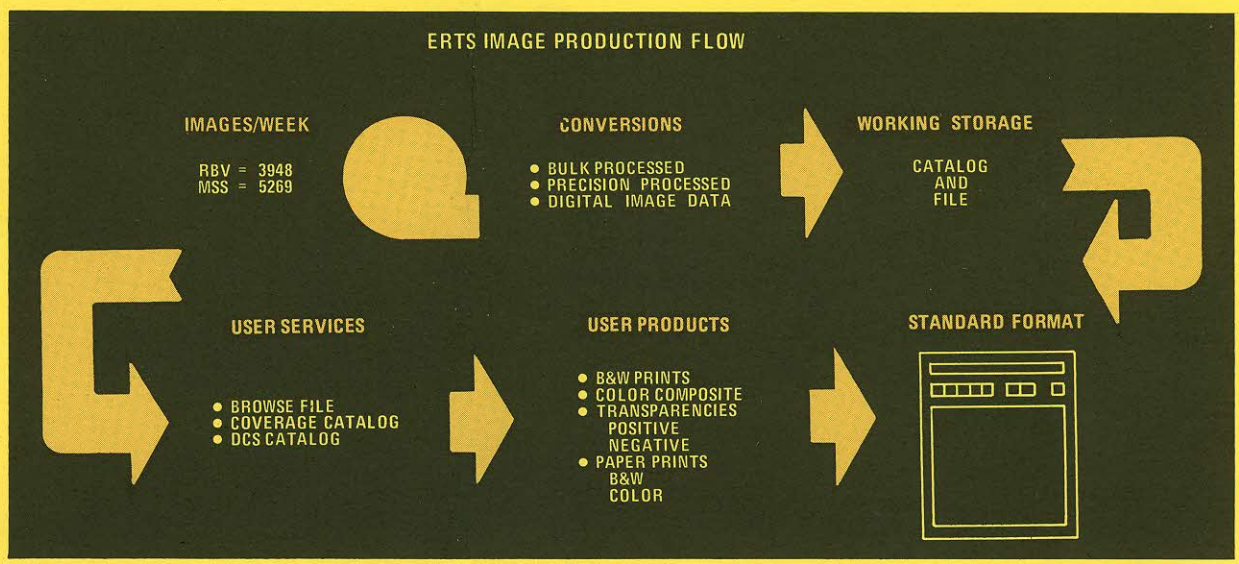
USER PRODUCTS

Data requests from users will be photoprocessed in either black and white or color from copies of images stored in the master file. Samples of bulk and precision imagery and color composites will be available to aid the user in selecting the most usable material.

STANDARD FORMAT

Images on the standard format will be to a scale of 1:1,000,000 of the 100-mile square image area. Annotation supplied with each image will include such useful information as: sensor, spectral band, date and time of exposure, and sun angle.

GENERAL ELECTRIC



For Further Information:

General Electric Company
Space Division
Product Information
P.O. Box 8555
Philadelphia, Pa. 19101