

## REMOTE SENSING IN THE NPS.

### 1. Introduction

Remote sensing is the gathering of information without actually coming in contact with the subject you are interested in. Although the science of remote sensing is fairly old, the NPS is a relative newcomer to the field.

#### Chronology

1794 French used balloons to observe troop movements.  
1839 First Photos  
1858 First air photos from balloons  
1909 First photo from an airplane (a motion picture!)  
1910 First still photo from an airplane  
1946-1950 First space photos from German V-2 rockets at White Sands, New Mexico.

### 2. Types of Imagery Available

Mercury Program---First unmanned flights all had cameras. All of the manned Mercury flight series are in color and, with the exception of the last flight, all had problems with exposure or dirty windows. Photos are all from the early 1960's.

Gemini Program----This program produced some 2,400 photos, almost all in color, between March 1965 and November 1966, mostly between 32 degrees N and S latitude. In the USA this is the Southwest, Gulf Coast, and Florida. Scale about 1: 2,400,000 and the photos cover about 85 miles on a side.

Apollo Program----This photographic program covers mostly the Southwest, South Central, and Southeastern US and northern Mexico. The best photos are from Apollo 9 (March 8-12, 1969). The final Apollo flight in July, 1975, had poor overall quality.

Landsat (ERTS)---- the Landsat (formerly called the Earth Resources Technology Satellite) satellites do not take photographs as such. The primary image producing element in Landsat is a device known as the Multi-Spectral Scanner (MSS). This system collects data in four spectral bands or channels. Two of these channels are in the visible portion of the spectrum and two in the near infrared. The data are transmitted to ground data acquisition centers in Alaska, California, and Maryland or may be stored on tape for transmittal at a later date or more convenient time. This tape storage and transmission has been one of the biggest problems of Landsat. The satellite signals are converted into an image format at the NASA Goddard Space Flight Center. For each scene an image is produced in each of the four spectral bands. A Landsat image covers 115 x 115 statute miles and the images are formatted to have 10% overlap along the orbital track. The spatial resolution of the MSS is about 260 feet, equal to a picture element (pixel) of approximately 1.1 acres.

Images of the individual MSS bands can be obtained as either prints or transparencies and at scales ranging from 2 x 2 inches to 29.2 x 29.2 inches. A popular product has been a color image called a "color composite." This is produced by combining three of the MSS bands in registration and sequentially exposing through appropriate color filters onto color film. These are normally produced at the enlarged 1: 1,000,000 and the resultant image enlarged to other scales. Many of the better and more cloud-free scenes have been treated this way and thus a color print or transparency can be ordered at the standard product price. Healthy vegetation is red, clear water is black, sediment-laden water is powder blue, and urban areas are often blue-grey or blue.

Skylab Program---During the three manned portions of the Skylab program over 35,000 frames of photographic imagery were acquired by Skylab cameras. These photos provide a contact image size of  $2\frac{1}{4} \times 2\frac{1}{4}$  inches with a ground coverage of 101 statute miles. Coverage includes most of the conterminous United States, portions of Europe, Africa, the Middle East, Asia, Australia, and a good portion of South America.

NASA Program---This ongoing program within the U.S. deals with aerial photography available from approximately 3,000 feet to U-2 flights of up to 60,000 feet. The 9 x 9 format at 1: 120,000 shows an area of approximately 17 miles on a side. This photography is available in black and white, color, or false color IR. This is usually excellent photography but is not available for all areas.

### 3. Some Uses of Remote Sensing

A. Vegetative mapping-----This is a rapidly growing field which is or has been used with varying results in several NPS areas. A sample follows:

The Congaree Swamp was mapped with MSS from aircraft but a number of problems, including ground-truthing techniques, led to poor results.

Yellowstone National Park has a rather gross vegetative map done with remote sensing and there are plans being made to complete Canyonlands and Arches vegetative map.

Crater Lake has an excellent vegetative map done by Oregon State University using Landsat data. Lake Mead is using MSS data to map both the geological features and vegetation and Pictured Rocks is using both Landsat data and photos but the computer enhancement is not being used.

Olympic, Death Valley, and Shenandoah are all being considered for future projects by the remote sensing workers in the Denver Service Center.

One quite ambitious project ongoing is in the Big Thicket in east Texas. The NPS is working with NASA to do a complete vegetative map with about 10 classes of vegetation and landforms. Additionally, other information such as soils, hydrology, slope and aspect are being digitized and should provide an excellent beginning to a complete information base. This project should be finished and the report out by January 1, 1978.

#### 4. Other Uses

Infrared sensing is being used to measure the energy radiated from the earth. So far it has been used to reveal volcanic activity, study forest fires which are obscured by smoke, measure soil moisture, and locate thermal pollution sites.

Several studies using Landsat, conventional photography, and infra red have shown the feasibility of locating underground aquifers, studying their recharge and discharge, and locating and monitoring strip-mine sources of acid mine drainage.

One of the more interesting uses was recently developed at the EROS lab in Mississippi. They are using color-infrared to locate mosquito breeding grounds and report "remarkable" success. They indicate that they are to the point that they are ready to offer a course in this field to entomologists. Many other uses for remote sensing data are found in your handout EROS, Reprint # 199.

#### 5. Training

A variety of courses are given at both the EROS centers. For information contact:

User Services  
EROS Data Center  
Sioux Falls, South Dakota 57198  
Phone: 605-594-6511 Ext. 151  
FTS: 784-7511

or User Services  
EROS Applications Assistance Facility  
National Space Technology Laboratories  
Bay St. Louis, Mississippi 39520  
Telephone (601) 688-3541

#### 6. For Specific Assistance in NPS

Dr. Maurice Nyquist, Denver Service Center, Box 25287, Denver Col. 80225 (FTS 234-4527) is currently heading up the NPS efforts in the Service Center. Mr. Ted Dinkel, NPS, National Science Technology Lab, NSTL Station, MS 39529 (FTS 494-2362) is a remote sensing expert who will be happy to be of assistance.