Remote Sensing: An Introductory Exercise for Classroom Use

EROS Data Center
Sioux Falls, South Dakota
August, 1983

EROS DATA CENTER REMOTE SENSING EXERCISE

Introduction

Teachers are encouraged to use this exercise as part of other studies. Assignments could be given for reports on space programs, agricultural practices, flood control, other Earth science projects, the history of Sioux Falls (using old photos), or on uses of photography.

To introduce the exercise, the teacher should select a student who will be asked to describe what he sees from various perspectives.

The student begins by describing an object directly in front of him in a corner of the classroom. The student then moves back a number of feet, still describing the object, though now from a different perspective. Finally, the student should move as far away from the object as possible and should describe the object and its surroundings. The group or class can discuss each set of descriptions offered from different distances, and how different perspectives and different levels of information have certain advantages and limitations.

The discussion involves the application of "remote sensing," a general term which means gathering information from a distance. When a student stands away from an object and observes it, he is using a type of remote sensing. The development of sophisticated camera and electronic scanner systems, attached to aircraft and satellites, permits remote sensing to become a system for recording, on film or computer tape, the information about that object in the distance. Scientists gather and record information about the Earth's surface, analyze that information, and make interpretations based on the information gathered.

The EROS (Earth Resource Observation Systems) Data Center is very much involved in remote sensing. The Center serves as a main storage, reproduction, and distribution facility for U.S. Government aircraft and

and satellite remotely sensed data. Scientists at the EROS Data Center are involved in research and training activities using remotely sensed data for natural resources inventory, planning, and management. For example, geologists have used satellite data to mark ancient gravel deposits formed along the edge of glaciers which once covered this area. These gravel deposits are now important reservoirs for underground water.

The data gathered from aircraft and satellite systems serve as a permanent record for researchers gathering information on study areas. Photographs taken from aircraft flying up to 15 km (8 miles) above the Earth's surface can offer scientists highly detailed information. Satellite data, recorded from 594 km (431 miles), offers the advantages of broader perspective of landform units and world wide, repetitive coverage. Data gathered by the satellite system are available in photographic formats or on tapes which can be processed by computer analysis equipment.

While aircraft and satellite systems offer different perspectives, each has advantages in the analysis of natural resource problems. Certain problems will require detailed, site-specific information; other analysis problems will require regional or repetitive coverage.

The photos used in this exercise introduce two perspectives from which the city of Sioux Falls can be examined.

-

Sioux Falls Aircraft Photo Mosaic

This color-infrared (CIR) photo is made from a series of individual photos mosaicked to give a representation of Sioux Falls in July 1979. The photos were acquired by an aircraft flying 3 km (1.7 miles) over the city. Infrared film was used because it is more sensitive to land cover differences than the film with which most of us are familiar. Healthy green vegetation shows as variations of red in color-infrared photography.

The photo covers Sioux Falls and the immediate surrounding area. The class should start by determining how much area is covered in the photo. Students can roughly determine the distances by measuring the areas in the lower right corner of the photo where county roads mark one-mile units. Secondly, the class should determine directions. (Which way is north in the photo?)

A number of features can be identified, in the photo. The class should use size, shape, tone (color), and association (relationship to other features) to identify features. The following features are listed by increasing difficulty of identification. The teacher should select representative features from the list:

1. The airport (How long are the runways?)
2. The Sioux River system (Can you tell which part has been channeled? How?)
3. The downtown business district
4. The shopping malls
5. The Interstate Highway system
6. Major streets (which are the major north/south and east/west streets?)
7. The Sioux Empire Fairgrounds racetrack
8. Woodlawn Cemetery

9. Old and new residential areas

10. Oil storage tanks

11. The Starlite and East Park Drive-In theaters

The class could also look at the farm units surrounding the city. Discussion could follow about the tone (color) differences and their relationship to crop types and conditions. Within the city, vegetation cover may suggest land use (for example, the heavily vegetated area of the cemetery, the larger number of trees in older residential neighborhoods, and the vegetation features of golf courses).

Two of the more difficult features to identify are the drive-in theaters, which can be identified by the pattern showing a feature focusing toward a smaller unit (the screen). Since the East Park theater on the east/center portion of the photo no longer exists, discussion of the principle of photography as a record of change might be appropriate.

A delineation of the major drainage network around the city demonstrates the techniques of extraction of natural resource information from the photo. Surface water shows as black. The class should mark the water units. Straight units (channeled, flood-control sections), the mottled pattern and small ponds in the extreme south-west unit, and the density of feeder channels are all indicative of soil material, elevation differences, or effects of man-made river control.

Landsat Scene E-40079-16390

The Landsat satellite Thematic Mapper image was acquired October 3, 1982, by the fourth in a series of Land study satellites. The satellite, which is 694 km (431 miles) in space, collects data over the entire earth (except for the areas immediately surrounding the poles). It takes the satellite 16 days to complete a cycle of world coverage.

The photo for study, which simulates a color-infrared print, is an electronic and computer generated representation of data acquired by the thematic mapper scanner. The photo covers an area 185 km (115 miles) square. Portions of Nebraska, Iowa, Minnesota, and South Dakota are shown.

The class could begin their study by describing just what they see. What do the shades of red represent? What is the blue area across the lower fourth of the photo? What are the light blue areas scattered around the photo? Given a general unfamiliarity with satellite photos, the class should spend some time discussing generally what they see before going into feature identification. They should review scale, direction, and vegetation characteristics. Using principles similar to those used in the color infrared aerial photo, the class could then be asked to identify:

1. Two lakes. How were they formed? How does the large area perspective of the satellite photo suggest source of water?
2. Two large cities. What detail is available? How are the cities linked?
3. Smaller cities and towns? The satellite photo shows a series of towns along the Sioux River basin. Why are the towns where they are?
4. Different vegetation densities. Why is the east (Iowa) section more "red" than the west section?

5. River systems. How many river systems can be identified?

6. Forests. In the extreme southeast corner, by the large river, is a dark red pattern representing dense tree stands. Why are these stands of trees where they are?

The satellite photo gives an expanded perspective to a study area. Cities can be seen in relationship to river systems and landforms. Vegetation change is related to soil types, surface water availability, terrain differences, and precipitation bands. A study of the broad drainage network helps to delineate landform differences.

The combination of aerial photos and satellite data gives detailed and regional perspectives on study areas. Together they help scientists learn about natural resources in those areas.