"To envision information—and what bright and splendid visions can result—is to work at the intersection of image, word, number, art."
Edward R. Tufte

Chapter 5 Remote Sensing

Big Brother is watching you ...

What is remote sensing?

We perceive the surrounding world through our five senses. Some senses (touch and taste) require contact of our sensing organs with the objects. However, we acquire much information about our surrounding through the senses of sight and hearing that do not require close contact between the sensing organs and the external objects. In other words, we are performing remote sensing all the time.

Figure 5.1
Earth from space

Generally, remote sensing refers to the activities of recording/observing/perceiving (sensing) objects or events at distant (remote) places.

Remote sensing is defined as the science and technology by which the characteristics of objects of interest can be identified, measured or analysed without direct contact. Remote sensing deals with gathering information about the Earth from a distance. This can be done a few metres from the Earth's surface, from an aircraft flying hundreds thousands of metres above the surface or by a satellite orbiting hundreds of kilometres above the Earth.

Figure 5.2
Remote sensing satellite

Remote-sensing satellite

Remote-sensing satellites are equipped with sensors that look down at the earth. They are 'eyes in the sky' constantly observing the earth (Figure 5.2).

Why remote sensing?

Remote-sensing satellite images gives a synoptic (bird's eye) view of any place on the Earth's surface. This allows us to study, map and monitor the Earth's surface at local and/or regional/global scales. It is cost effective and gives better spatial coverage compared to ground sampling.

How does remote sensing work?

Electro-magnetic radiation reflected or emitted from an object is the usual source of remote sensing data. A device to detect the electro-magnetic radiation reflected or emitted is called a remote sensor or sensor. Cameras or scanners

are examples of remote sensors. A vehicle to carry the sensor is called a platform. Aircraft or satellites are used as platforms.

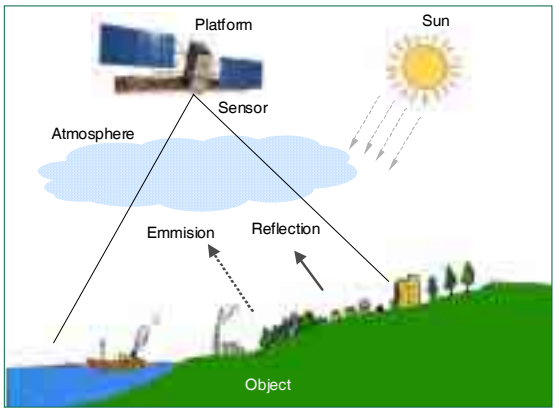

Figure 5.3
Remote-sensing

The characteristics of an object can be determined using its reflected or emitted electromagnetic radiation. That is 'each object has a unique characteristic of reflection or emission if the object type or environmental conditions are different'. Remote sensing is a technology to identify and understand the object or the environmental conditions through the uniqueness of its electro-magnetic reflection or emission. This concept is illustrated in Figure 5.3.

Types of remote-sensing images

Presently there are several remote-sensing satellite series in operation. Different satellite systems have different characteristics—e.g. resolutions, number of bands—and have their own importance for different applications. Some major satellite systems and their major characteristics are given in the table below.

Remote-sensing images

Remote-sensing images are normally digital images (Figure 5.4). In order to extract useful information, image processing techniques are applied to enhance the image to help visual interpretation, and to correct or restore the image if the image has been subjected to geometric distortion, blurring or degradation by other factors. There are many image analysis techniques available and the method used depends upon the requirements of the specific problem concerned.

Use of remote-sensing data in GIS

Remote-sensing data can be integrated with various other geographic data. There has been an increasing trend in integration of remote-sensing data into

Figure 5.4
Satellite Image of Kathmandu

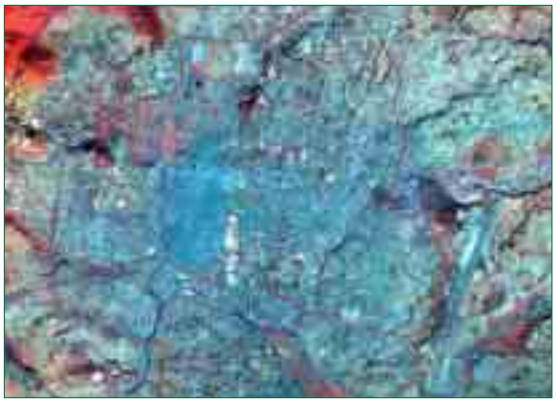

Figure 5.5
Kathmandu urban area observed from an ADEOS-AVNIR M Japanese satellite image, 1997, and overlaid with road and river features

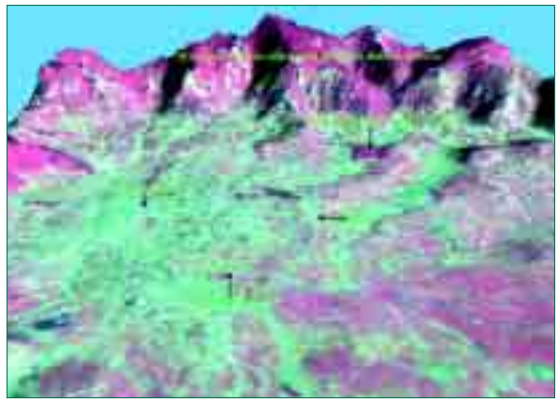

Figure 5.6
3-D perspective of the Kathmandu valley generated by draping a LANDSAT-TM, 1988, satellite image over a DEM

GIS for analytical purposes. There are many ways to use remote-sensing data; some examples are illustrated as below.

Land cover maps or vegetation maps classified from remote-sensing data can be overlaid on to other geographic data to enable analysis for environmental monitoring and its change.

Image data are sometimes also used as image maps, with an overlay of political boundaries, roads, rivers, etc. Such an image map can be successfully used for visual interpretation (Figure 5.5 and 5.6).