Plumb, D. A. (1999). *Science 9*. Scarborough, Ontario: Nelson Canada. Page 496 & 449

## 16.4 Case Study

# RADARSAT

In the spring of 1997, people in Manitoba were faced with one of the worst floods in their history. Soon after the flood began, satellite images helped emergency crews plan disaster control and relief (**Figure 1**). These images were provided by RADARSAT, a highly successful satellite system designed, built, and operated by Canadians.

Helping in emergencies is only one of the many uses of RADARSAT, as you will see.

The word **radar** is short for "radio detection and ranging." This means that a radar device emits bursts of radio waves and picks up their reflections to detect objects (detection) and find out how far away they are (ranging). Radio waves travel at the speed of light and can pass through clouds, so they can be used in all types of weather and at night.

(a) What are advantages of radio waves over visible light?

(b) Brainstorm some other uses of radar.

As its name suggests, RADARSAT is a satellite system that employs radar. It looks at features on land and on oceans using radio waves. Bats use a similar system of emitting high-pitched sounds and interpreting the reflections off obstacles or food sources.

In addition to floods, RADARSAT helps in various large-scale emergencies, such as earthquakes, mudslides, ice storms, ice jams, and oil spills on the ocean.

(c) How might RADARSAT help in your local area?

Many industries benefit from RADARSAT images. Many resources, such as oil, natural gas, water, and minerals are found underground. Often the surface features on the ground help scientists predict where these resources are. These surface features are much easier to find using satellite images. Images also let us monitor crop conditions, forests, soil humidity, river flows, fish stocks, and shipping conditions.

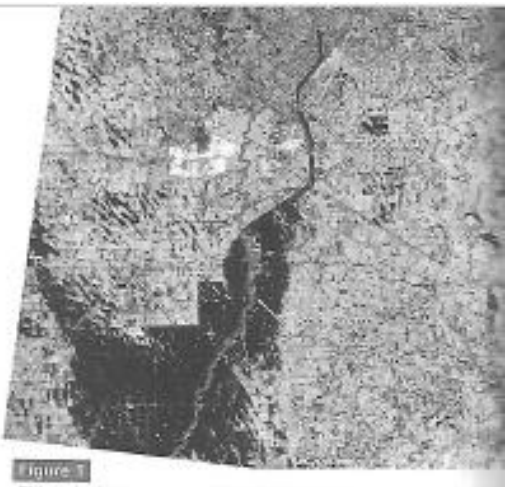

Figure 1
This radar image of part of Manitoba has been computer enhanced, so different features show up as different colours. The red line shows the normal course of the river. The blue area shows the area under floodwaters in 1997.

(d) Why might it be better to search for underground resources by using RADARSAT images than by ground surveying?

In order to provide a healthy planet for future generations, humans must learn to protect our environment. Satellites help us monitor the environment and make wise decisions about our actions.

(e) RADARSAT is an expensive system, but it provides great benefits. Is it worth the cost? How do we decide?

### Understanding Concepts

1. In a list, summarize the benefits of using RADARSAT.

### Exploring

2. Compare the properties of radio waves with the properties of other parts of the electromagnetic spectrum. (For more information about the electromagnetic spectrum refer to Section 14.6, page 449, or use a separate resource.)
3. Research other animals, besides bats, that use a ranging/detection system similar to RADARSAT. Compare the systems.

Looking through a telescope at objects in the sky can be rewarding and informative. However, astronomers use another way to obtain detailed permanent images of objects in the sky. They attach an instrument, such as a digital camera, to the telescope. As the telescope follows the object across the sky, gathering light for minutes or hours or even days, more details are captured. Because the camera gathers more light from the object over time, the resulting images show stars and galaxies too faint to be seen with our eyes alone (**Figure 2**).

Figure 2
These views of the same object show how the amount of detail increases as the time that the camera gathers light increases. In order from top to bottom, these images show light-gathering times of 1, 5, 30, and 45 min.

## Using Invisible Energies

What do you do when you want to receive radio signals sent out by a radio station? You simply tune your radio to receive them. What do astronomers do when they want to receive the radio waves sent out by some star or other object in the sky? They aim a radio receiver toward the object and try tuning the receiver until it receives waves from space.

Radio waves belong to a broad band of energies called the **electromagnetic spectrum**. This spectrum consists of radio waves, microwaves, infrared rays (heat), visible light, ultraviolet rays, X rays, and gamma rays. These types of energy are emitted (given off) by stars, galaxies, and other objects in the universe. These waves all travel at the speed of light in a vacuum, and they have energies that become greater as their wavelengths become smaller. Studying these types of energy helps astronomers understand more about the universe.

A device that receives radio waves from space is called a **radio telescope**. It is able to detect radio waves that are emitted by stars and galaxies. A radio telescope can work even on cloudy days because radio waves can pass through Earth's atmosphere, including clouds, very easily.

Radio telescopes often look like giant satellite dishes. The dish part, which may be made of wire mesh, reflects the radio waves to a collector held just in front of the dish. The radio telescope shown in **Figure 3** is the largest single radio telescope in the world, measuring more than 300 m in diameter. It was made by placing a concave wire mesh in a valley in the mountains. This radio telescope receives radio signals from many different parts of the universe, day and night, as Earth rotates.

Figure 3
The Arecibo radio telescope is built into the mountains of Puerto Rico. What is the triangular structure just above the "dish"?