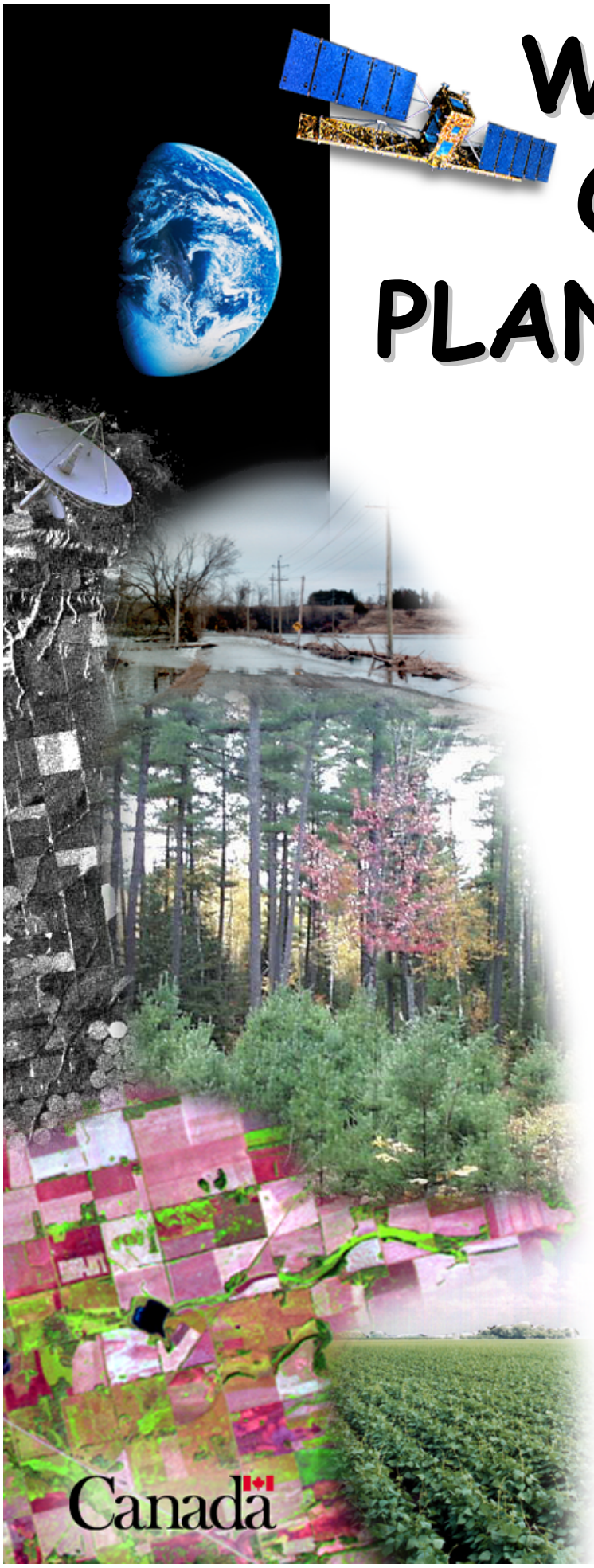

WATCHING OVER OUR PLANET FROM SPACE

Hands-on activities for young people on monitoring the Earth's environment using remote sensing

from the
Canada Centre for Remote Sensing

version 1.1.0

Natural Resources Canada
Ressources naturelles Canada

Watching Over Our Planet From Space

is

a series of hands-on activities for young people
(but quite suitable for not-so-young people)
on the topic of monitoring the Earth's environment from
space using satellite images

from the

Canada Centre for Remote Sensing
Natural Resources Canada

Version 1.1.0
February 2000

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A free digital version is available for download in the
Education chapter of the CCRS website at:
www.ccrs.nrcan.gc.ca

WATCHING OVER OUR PLANET FROM SPACE

An Earth Observation education kit for elementary schools from the **Canada Centre for Remote Sensing, Natural Resources Canada** Version: 1.1.0

This education kit introduces the subject of **Remote Sensing,** also known as **Earth Observation,** to children aged 11-15. It is based on a series of short activities dealing with the interpretation of satellite images for application to environmental monitoring and the management of natural resources in Canada.

Table of Contents

1.1 About this Tutorial

Educational Objectives

After completing several of the activities in this tutorial, the student:

- will be familiar with the basic concepts of "remote sensing" technology;
- will be able to recognize/interpret some features in satellite images;
- will be able to describe how remote sensing contributes to monitoring the environment.

Content

The material in this tutorial makes use of Canadian examples of environmental monitoring.

Presentation of the Material to Students

Sections 2.1, 2.2 and 2.3 should be carefully examined by the students. Sections 4.1, 4.2, 4.3 are intended as additional reading; Appendices A, B, and C, may be useful resources while working on the activities. The answers are found in Appendix D. The activities in Section 3 are presented in a recommended order.

Level of Difficulty

These activities and exercises are intended for children aged 11 and up. Some of the activities will be more suitable for older children. Length of time required for each activity varies between 5 and 30 minutes.

Format

It is anticipated that this tutorial will be used in a classroom setting. The activities can be completed by students working either individually or in small groups. While the current version of this tutorial is intended for use as a printed copy, an electronic / interactive version is in development. Watch the CCRS Web site (www.ccrs.nrcan.gc.ca) for news about such a module, as well as additional tutorials.

Considerations Regarding Printing

The tutorial pages should be printed on a colour printer. Please use the best quality colour printer and paper that is available and check the results to ensure that features referred to in the exercises are indeed visible in the printed version.

Prerequisite Knowledge

The student should be familiar with:

- Cartesian co-ordinates (x, y) for referencing locations of features in the imagery;
- the cardinal points of the compass;
- map reading.
- See Appendices for descriptions of Cartesian co-ordinates, points of a compass and the dot grid technique for measuring area.

Acknowledgements

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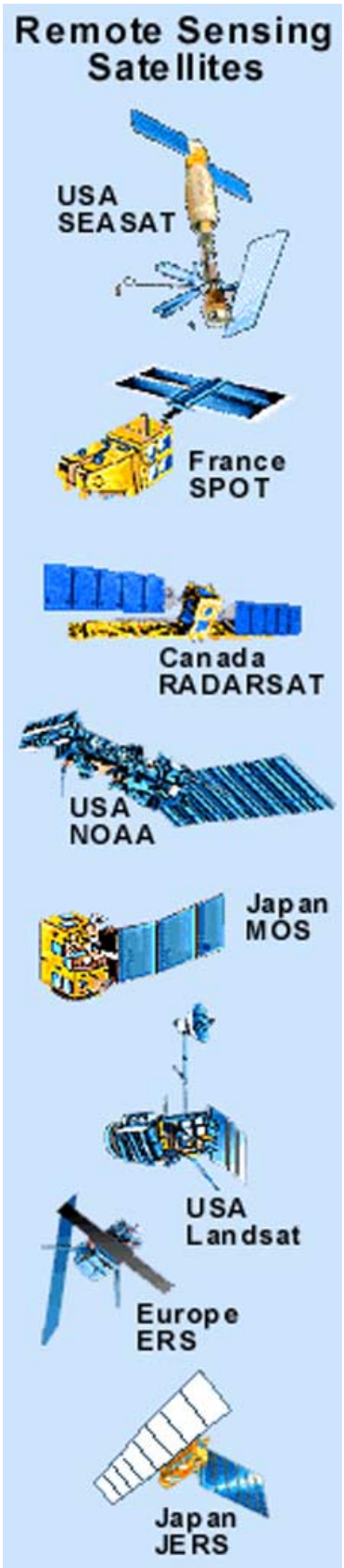
- MAS staff: Tom Alföldi, Berthe Boucher, Julie Chartrand, Heather Dickinson, Fran Pearl, Rhonda Sabino, Joanne Straby, Andrew Trebble, Marguerite Trindade
- Lingua / Services Momentum for French translation
- Other CCRS contributors: Joanne Ellis, Caroline Forest, Robert Landry, Josée Levesque, Mike Manore, Heather McNairn, Christian Prévost

Details of Activities

Description of Activity	Skills Development	Time Required	Level of Difficulty	Extra Materials Used
3.1 **Which is Which?** … Becoming familiar with the appearance of features (colour, shape, size, texture, etc.) in satellite imagery	Matching images with a description of features	10 - 15 min	Introductory	None
3.2 **Find it!** …Becoming familiar with the use of cartesian coordinates and the appearance of features in satellite imagery	Finding and determining the location of features on an image	15 – 20 min	Introductory	None
3.3 (a & b) **Measure This** … Recognizing features and measuring distances	Measuring distances, feature recognition, determining direction	25 - 30 min	Introductory	String
3.4 **Clearcutting in the Forest** …Monitoring a logging operation	Aligning an image and a map; measuring area	25 – 30 min	Challenging	Acetate and markers
3.5 **Oil Spill Danger** … Measuring and monitoring the motion of an oil slick	Measuring area, distance, speed and direction of movement (predicting change over time)	25 – 30 min	Challenging	Acetate and markers
3.6 **Crop Types** …Identifying crop types, other rural features and assessing flood damage.	Using an interpretation key to match features; position analysis	15 - 20 min	Moderate	None
3.7 **Forest Fire** …Becoming familiar with the strategies of fighting forest fires	Measuring distances; identifying routes; feature recognition	10 – 15 min	Moderate	Acetate, markers and string
3.8 **Navigating a Ship Through Ice** …Using a satellite image to navigate a ship through ice	Determine the best route and measure its distance	10 – 15 min	Moderate	String
3.9 **You Figure it Out** … Interpreting an image with coastal features	Multiple choice questions using image reading skills and contextual logic	20 – 25 min	Challenging	None
3.10 **Urban Land Use** … Identifying urban land use and colouring a land use map	Recognizing urban features in a satellite image from written descriptions	15 - 20 min	Moderate	Markers, or coloured pencils, or crayons
3.11 **At a Mine Site** …Observing the activity at a mine site using remote sensing imagery	Finding similar features on an image	20 - 30 min	Moderate	None
3.12 **A Different Perspective** … Matching oblique aerial photographs to corresponding satellite images	Comparing low-altitude oblique views to high-altitude vertical views	10 –15 min	Challenging	None



2.1 What is Remote Sensing?

"Remote" means far away. Remote sensing means sensing things from a distance. Of **our** five senses **we** use three as remote sensors when we:

a. watch a football game from the stands (sense of sight)

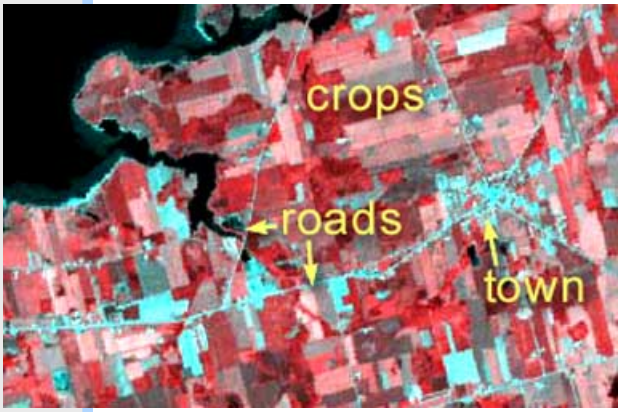
b. smell freshly baked bread in the oven (sense of smell)

c. hear a telephone ring (sense of hearing)

What are our other two senses and why aren't they used "remotely"?

In the world of science, "remote sensing" means observing the Earth with sensors from high above its surface. They are like cameras except that they use not only visible light but also other bands of the electromagnetic spectrum such as infrared, radar and ultraviolet. Because they are so high up, these sensors can make images of a very large area, sometimes a whole province.

Today, remote sensing, also known as Earth Observation, is often done from space using satellites. Many countries including Canada have them. Hundreds of images are sent every day from the satellites to receiving stations on Earth. The Earth's entire surface is imaged every week or so. Can you imagine how these images could be used?

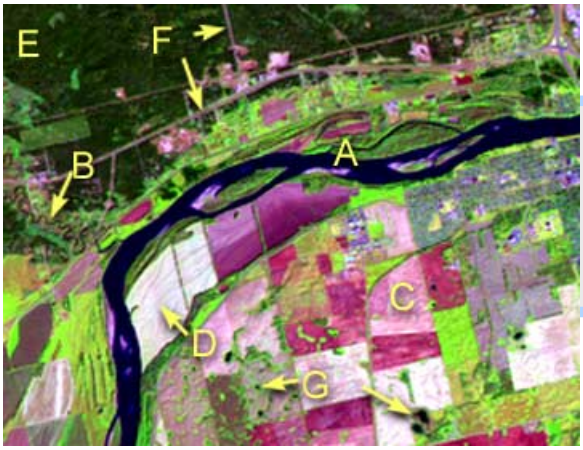


2.2 What Can You See on a Satellite Image?

You see the things that would be seen by eye or a camera if they were looking down from space. Because we can't see in parts of the spectrum like the infrared, ultraviolet or microwave, we have to use colours that we can see, to represent this kind of information. That's why many remote sensing images have strange colours.

In this view of downtown Vancouver, British Columbia, you can see:

A. Tall buildings and their shadows **B**. Bridges **C**. Residential street patterns **D**. A large stadium **E**. Marinas for small boats **F**. A ship and its wake

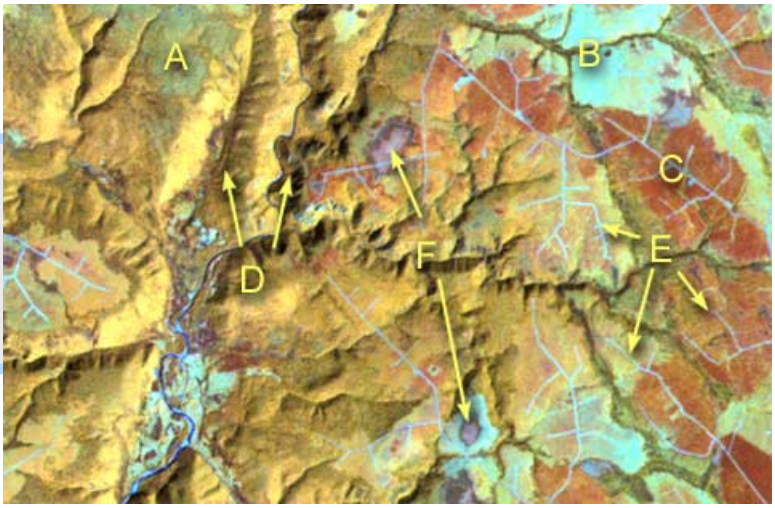


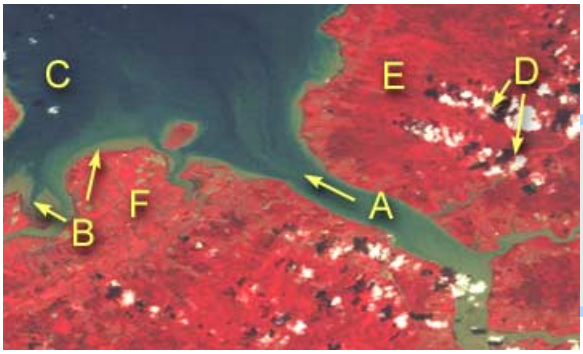
Near Prince Albert, Saskatchewan, you can see:

A. A large river **B**. A small, meandering river **C**. Farm fields with crops **D**. Farms fields showing bare ground **E**. Forest **F**. Roads **G**. Small ponds

In the Cape Breton Highlands of Nova Scotia, you can see:

A. Standing forest **B**. Recent forest clearcut **C**. Older forest clearcut **D**. Deep river valley **E**. Logging roads **F**. Swamp





In the Minas Basin of Nova Scotia, you can see:

A. A river carrying sediment into the Basin **B**. Shallow water areas **C**. Deep water areas **D**. Clouds and their shadows **E**. Forests

2.3 Who Uses Remote Sensing and Why?

. . . the geographer, who looks for changes on the Earth's surface that need to be mapped;

. . . the forester, who needs information about what type of trees are growing and if they have been affected by disease, fire or pollution;

. . . the environmentalist, who wants to detect, identify and follow the movement of pollutants such as oil slicks on the ocean;

. . . the geologist, who is interested in finding valuable minerals;

. . . the farmer, who wants to keep an eye on how his crops are growing and if they've been affected by drought, floods, disease or pests;

. . . the ship captain, who needs to find the best route through the northern ice packs;

. . . the firefighter, who sends out his crews based on information about the size and movement of a forest fire.

--- And there are many more ways to use remote sensing. ---

3.1 Which is Which?

Instructions: On the next pages you will find twelve satellite image segments. Can you find which image contains the feature(s) described below? Enter the correct image number in the box beside each "Feature Description". Be careful! Some images are used more than once!

Feature Description

☐ a) **Two race tracks,** a smaller one inside a larger one. Some roads and two golf courses are also visible in the image.

☐ b) **An airport** at the edge of a city. You can also see a smaller river joining a larger river in the image.

☐ c) The effect of **a cyclone** on the surface of ocean waters.

☐ d) A smooth coastline showing a coastal **town and its breakwater** which creates a safe harbour for boats.

☐ e) **5 bridges** across a river. Three of the bridges also pass over islands in the river.

☐ f) There are many **clouds** (and their shadows) over land and water in this image.

☐ g) A coastal area showing **ice flows** in the largest of the inlets. The land area is studded with lakes and there are many islands offshore.

☐ h) **A hook-shaped peninsula** ending in a point.

☐ i) A rugged coastline showing many **sharp coves and inlets**.

☐ j) This scene shows **farmland** near the mouths of 2 rivers. You can also see several roads meeting at a village.

☐ k) In this view you see many **lakes** in a rugged and rocky forest area. A large swampy section shows no lakes at all.

☐ l) A forested region showing clear-cut areas as well as the **logging roads** that were built to access this site.

☐ m) A mouth of a river showing **the sediment** that is carried by the river into the sea.

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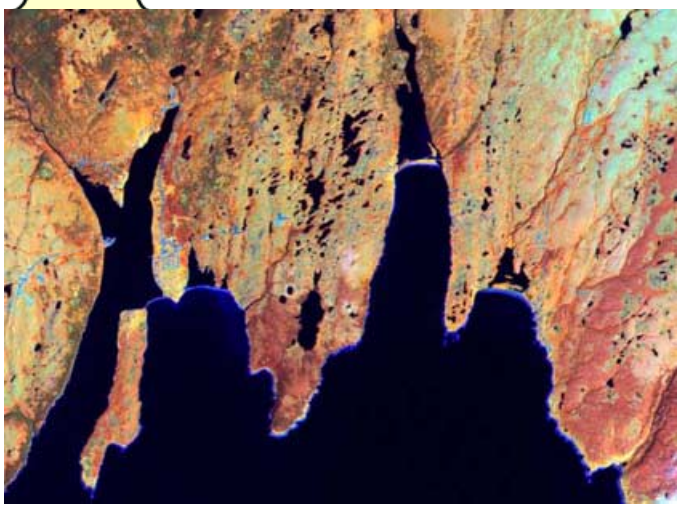

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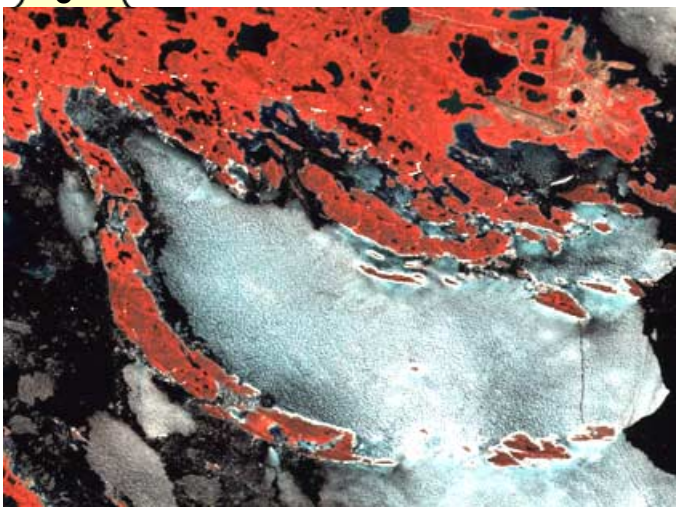

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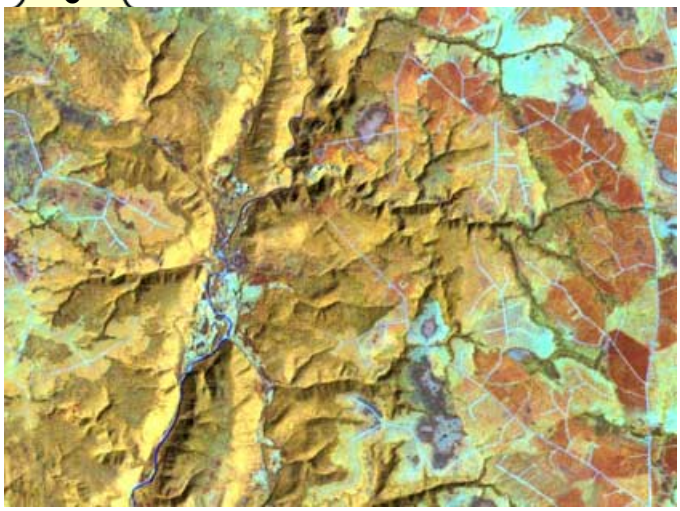

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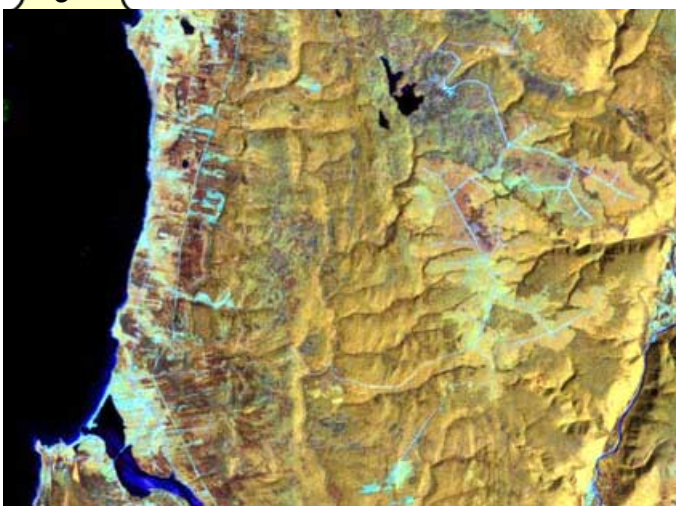

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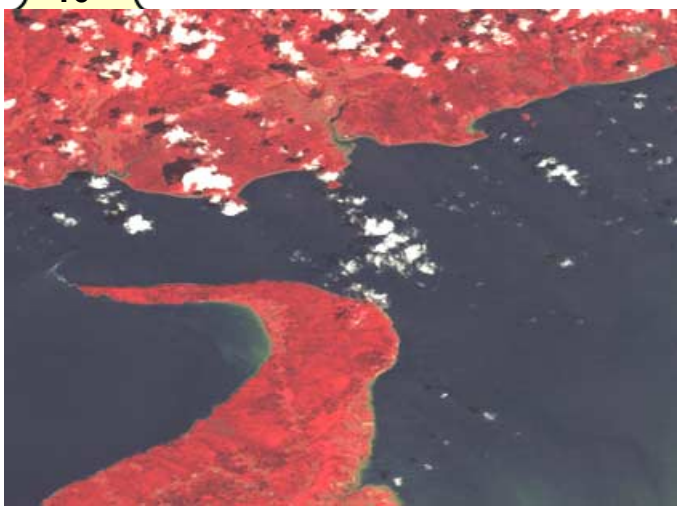

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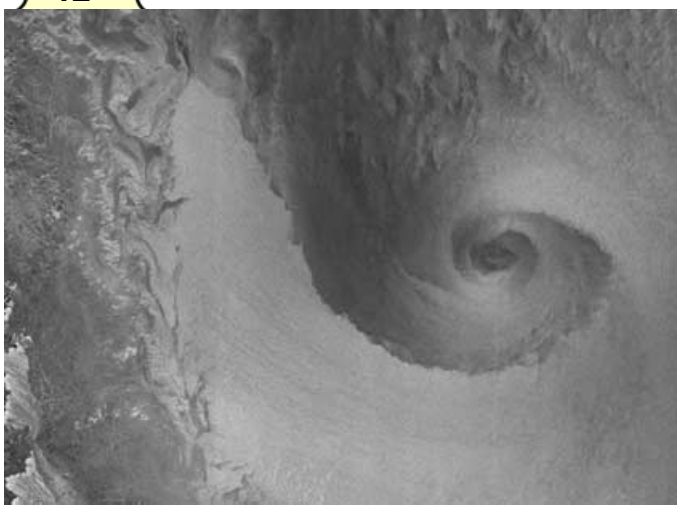


3.2 Find it !

Instructions:

In this Landsat satellite image of northern Saskatchewan, we see farm fields (pink and white and light green rectangles), forests (dark green), the town of Prince Albert (blue/purple), and the North Saskatchewan River (dark blue). The colours are strange because we are using information from parts of the spectrum that we don't normally see (like the infrared) and are showing them as colours that we do see. Lets find some more features in this image! Use the number coordinates on the edge of the image.

Find it ! - question 1 :

The town of Prince Albert is located at:

A: (5.5, 8.0)
C: (7.7, 6.1)
B: (5.6, 3.2)
D: (9.8, 11.4)

Find it ! - question 2:

The field located at: (3.2, 2.6) is the same colour (and therefore is of the same material) as the field at:

A: (5.2, 2.6)
C: (5.3, 1.1)
B: (4.7, 3.7)

Find it ! - question 3:

There is a long, meandering river which flows into the image at location: 0.0, 1.2. It is too narrow to see the water, but you can see the vegetation on the riverbanks. It joins (flows into) the North Saskatchewan River at:

A: (6.9, 6.1)
C: (8.2, 5.3)
B: (4.8, 6.7)

Find it ! - question 4:

There is a lake in the middle of the forest at:

A: (8.2, 4.2)
C: (2.2, 2.5)
B: (9.3, 9.8)

Find it ! - question 5:

The field at (5.4, 3.2) has several green dots in it. These are “sloughs” or small ponds surrounded by grasses and weeds. The water is too small to see in most cases but the vegetation shows as green. Another location of sloughs is at:

A: (1.9, 5.3)
C: (1.7, 8.5)
B: (5.0, 7.0)
D: (5.7, 8.0)

Find it! - question 6:

In the North Saskatchewan River are many islands. Some are without vegetation (pink/white) and some have grasses and shrubs (light green). One of these vegetated islands is at:

A: (4.4, 8.6)
C: (7.5, 7.5)
B: (5.5, 6.4)
D: (0.8, 7.7)

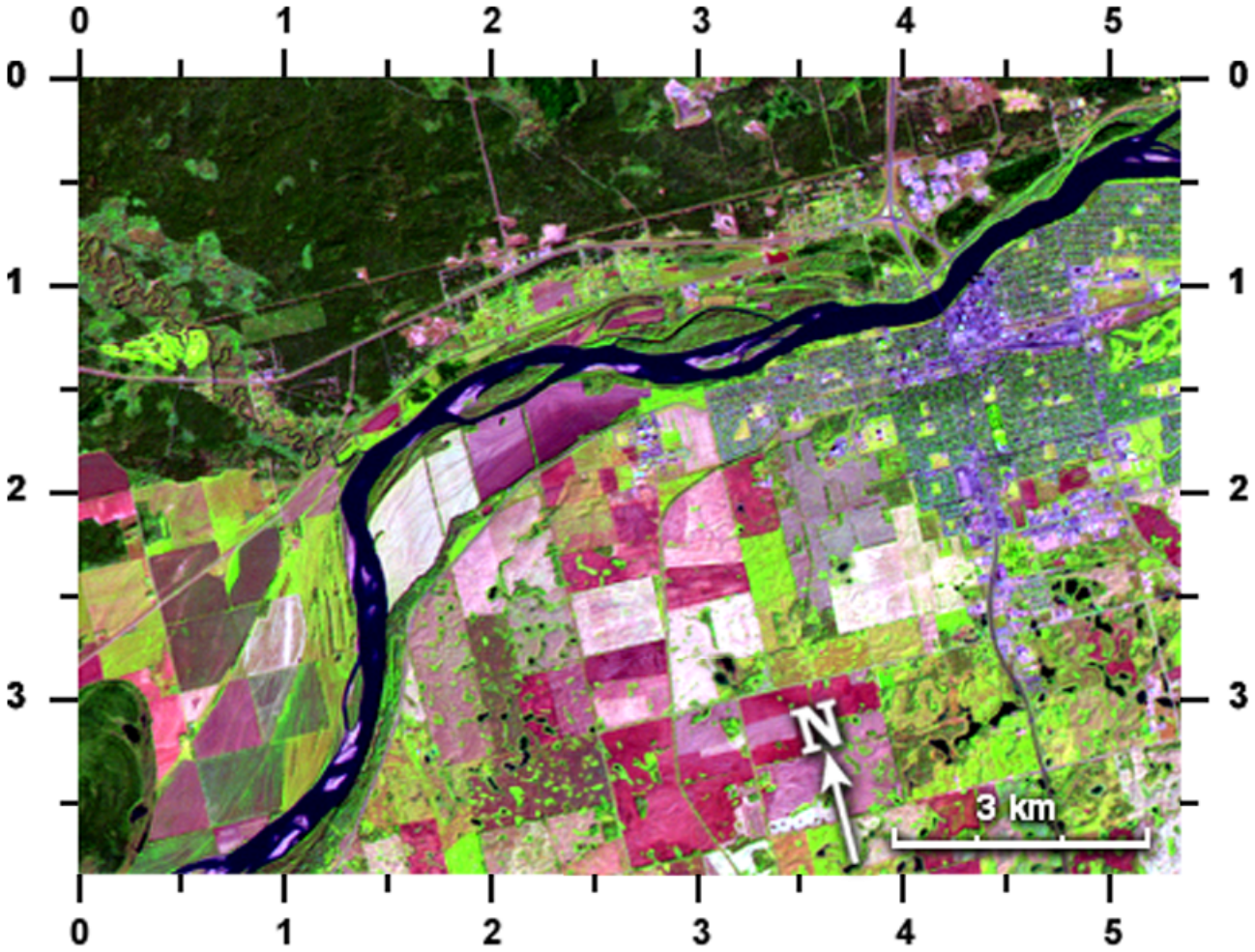
Find it ! - question 7:

Which road runs north-south? It is the one at:

A: (1.6, 6.4)
C: (2.0, 2.4)
B: (4.0, 7.3)
D: (5.3, 5.0)

3.3a Measure This (Northern Saskatchewan)

Instructions: Inserted in the Landsat satellite image of northern Saskatchewan, is a scale bar (3km) and a North arrow (bottom right of the image). These will help you to answer some of the following questions.



Saskatchewan - question 1:

Which road is oriented north-south? The one at:

A: (1.6, 1.2)
B: (3.1, 0.6)
C: (1.4, 3.0)
D: (2.0, 0.5)
E: (1.1, 0.6)

Saskatchewan - question 2:

Directly west of (1.6, 3.2) is a small island in the river which is:

A: light pink in colour (no vegetation)
B: green in colour (covered with vegetation)
C: has equal amounts of pink and green

Saskatchewan - question 3:

Find the town of Prince Albert (blue/purple) on the south shore of the big river (North Saskatchewan River). Look carfully for the bridge that crosses the river near the town. This bridge is:

A: almost 3 km long

B: more than 1 km long

C: much less than 1 km long

D: I can't tell how long without taking a trip there.

Saskatchewan - question 4:

If I wanted to take a boat trip along the North Saskatchewan River from where it enters the satellite image to where it exits the image, my trip length would be (a piece of string or a shoelace would help you in this task):

A: 17 km

B: 28 km

C: 14 km

D: 11.4467 km

Saskatchewan - question 5:

The very light pink/white field at: (2.6, 2.6) has an area of about:

A: between 2 and 3 square kilometres

B: a bit less than 1 square km

C: more than 4 square kilometres

Saskatchewan - question 6:

The yellow-green feature at (0.4, 1.3) is a golf course. If you lived in the town of Prince Albert, at (4.4, 1.1) and wanted to drive to this golf course, the distance would be about:

A: 12 km

B: 22 km

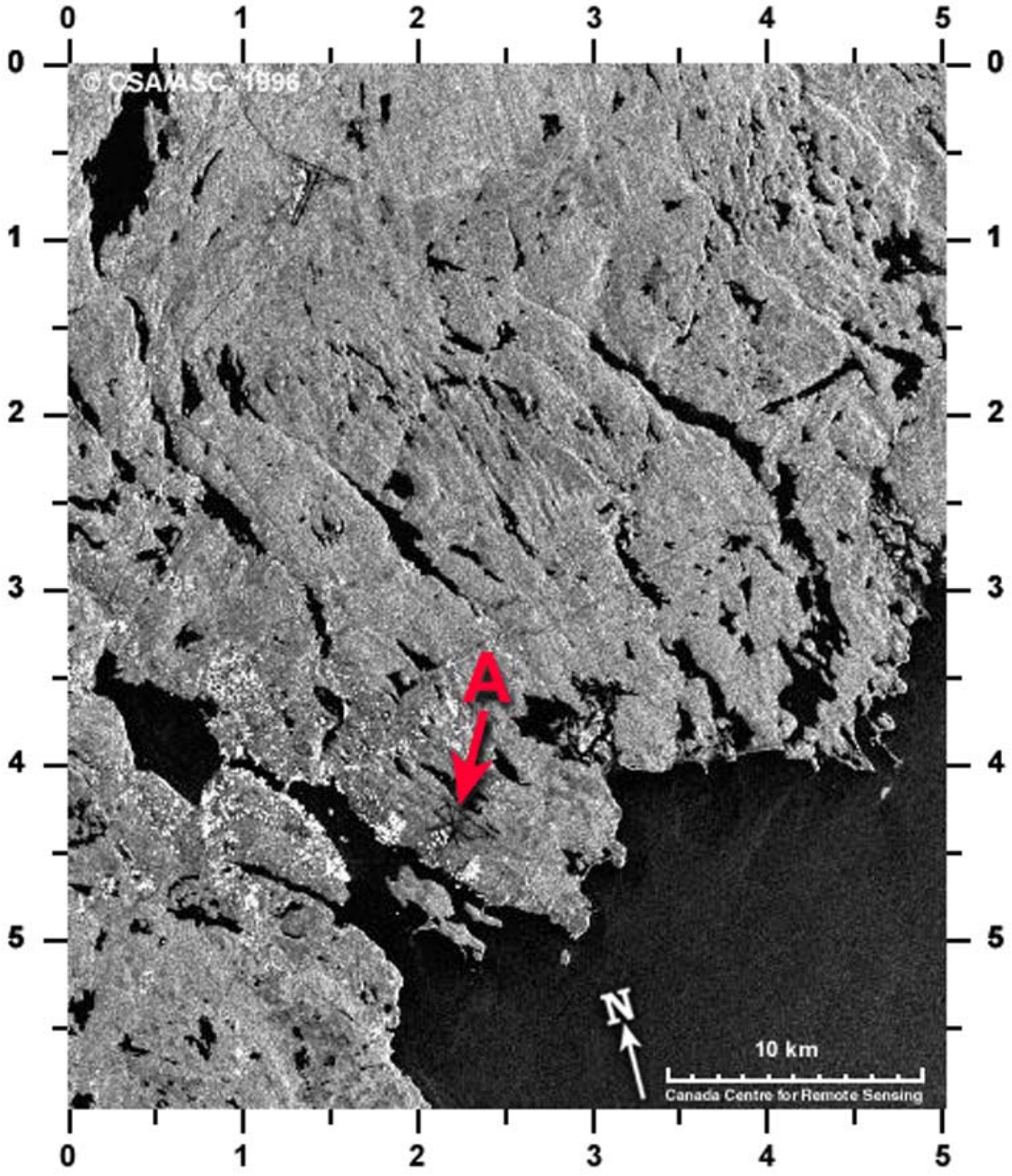
C: 8 km

D: 10 km

3.3b Measure This (Halifax area)

Instructions:

In the RADARSAT image of the Halifax area, the letter A is pointing to Shearwater airport. You can see the dark criss-crossing lines which are the airport runways. They are dark because on the ground they are smooth, just like the water bodies nearby (ocean at the bottom right and the many inland lakes). The many buildings in Halifax and nearby reflect the radar beams well, giving lots of bright spots on this image.



Halifax - question 1:

Find another airport in this image. The runways will be similar in appearance but not exactly in the same pattern. The other airport is at:

A: (1.6, 5.4)
B: (4.0, 2.6)
C: (3.9, 0.9)
D: (1.4, 0.7)

Halifax - question 2:

If you were flying from this other airport towards the ocean, you would be travelling:

A: south
B: south-west
C: north-west
D: west

Halifax - question 3:

Can you see any roads in this image? One road is located at:

A: (1.7, 2.7)
B: (1.2, 5.8)
C: (1.0, 1.2)
D: (4.0, 3.6)

Halifax - question 4:

The inner part of Halifax harbour is at 0.7, 3.9; the straight line distance from here to Devil's Island at 2.8, 5.1 is about:

A: 6 km
B: 16 km
C: 7 km