ACTIVITY Weather Radar Investigation

Introduction

Radar is an important weather observing tool used to locate areas of precipitation and to maintain a watch on the severity of storms. Meteorologists interpret bright images, called echoes, appearing on weather radar screens in order to acquire information about rain and snow areas.

Approach

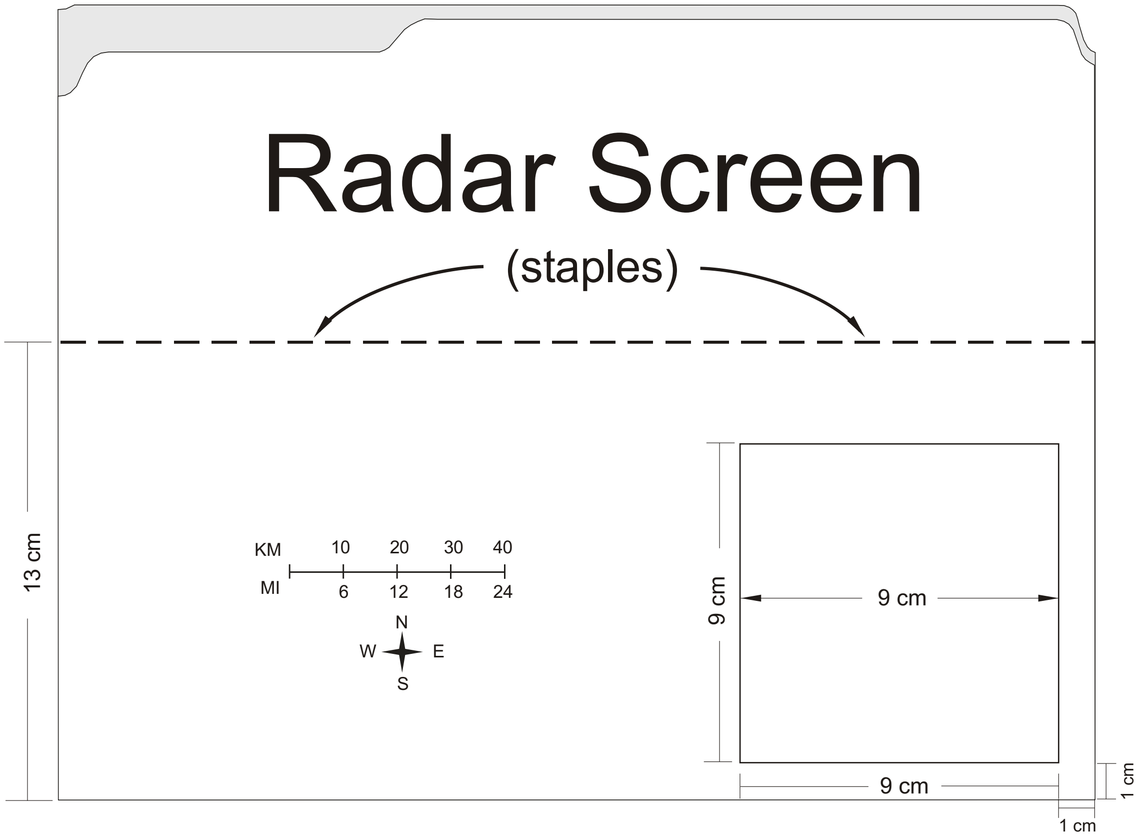
1. Construct a Radar Screen slide chart by following the directions given in the accompanying material.
2. Complete the radar activity entitled "Interpreting a Radar Precipitation Display".

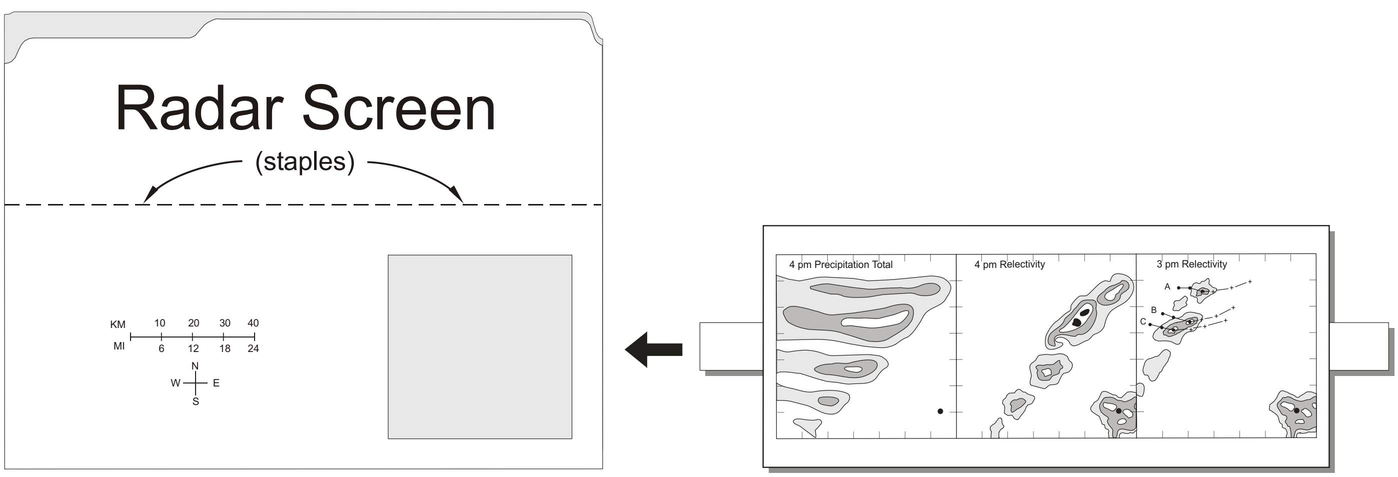
Additional Activities

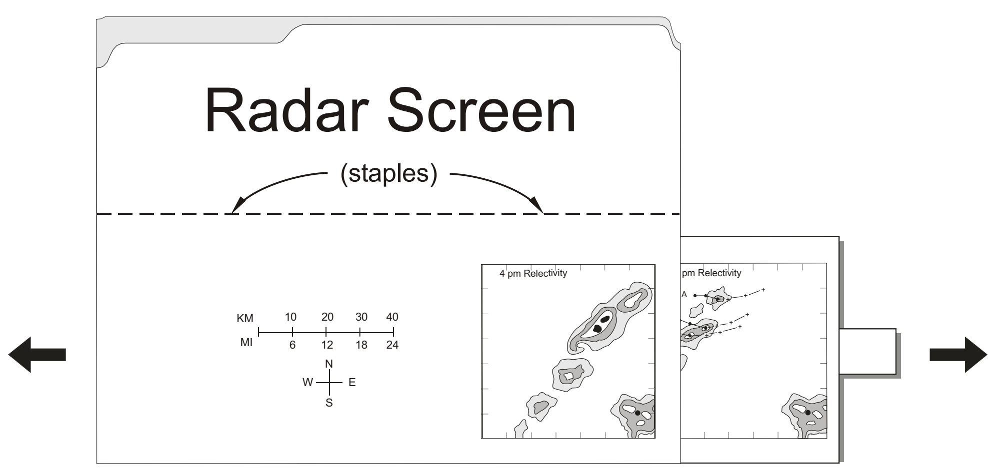
1. Go to the Environment Canada web site

   http://weatheroffice.ec.gc.ca

   Navigate to the RADAR page and examine a variety of weather radar images. Next select a recent weather radar image and compare the main features on the radar image with those features found on the weather chart and satellite image for the same time. Weather charts and satellite images can be found on the same web page by navigating to the appropriate menu selections
2. Set up simulated radar in a darkened classroom. Use a flashlight to represent the radar and hang mobiles of smooth and crumpled aluminium-foil pieces to depict areas of rain or snow. Swing the flashlight beam around or up and down to search for the precipitation areas. Set up a co-ordinate system to describe directions and distances to the "echo" sources.

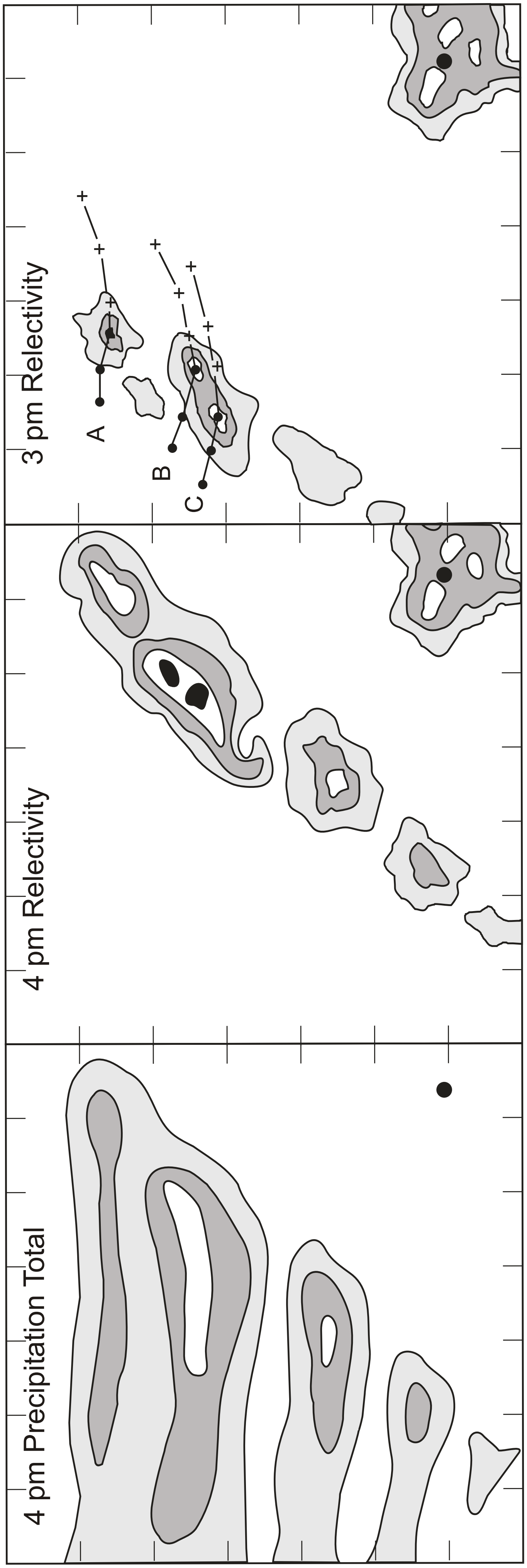

Radar Screen
(staples)
13 cm
KM 10 20 30 40
MI 6 12 18 24
N
W E
S
9 cm
9 cm
9 cm
1 cm
1 cm


Radar Screen
(staples)
KM 10 20 30 40
MI 6 12 18 24
N
W E
S
4 pm Precipitation Total
4 pm Relectivity
3 pm Relectivity
A
B
C


Radar Screen
(staples)
KM 10 20 30 40
MI 6 12 18 24
N
W E
S
4 pm Relectivity
pm Relectivity
A

Cut along dotted line

RADAR DISPLAY VIEWS



Radar Screen Construction

Materials:

Manila file folders, tape, scissors, transparent material, ruler, coloured overhead marking pen or grease pencil, stapler, pencil

Procedure:

Cut the RADAR DISPLAY VIEWS on the accompanying sheet along the dotted lines and attach by tape to a piece of manila folder cut to the same size. Mark and cut a 9 cm square viewing window in the lower front corner of a file folder. (see diagram on page 8) Secure the sleeve by stapling across the folder 13 cm from the bottom fold. Tape transparent material across the viewing window. Cut out the DISTANCE SCALE on the attached sheet and tape it to the left-hand side of the file folder. Cut out the pullers and tape at each end of the Radar-view strip. Insert the radar-view strip in the sleeve. In the lower right hand corner, find the black dot representing the radar site. Make a permanent reference mark on the transparent material representing this radar site. The Radar Screen is now ready for use.

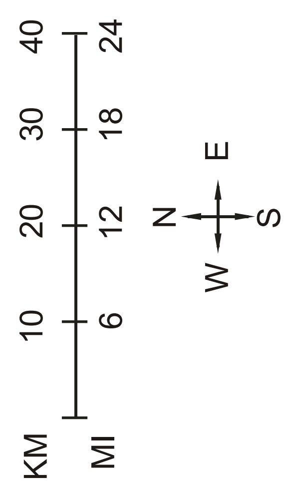
A version of the Radar Screen can be made for overhead projection. Cut the viewing window completely through a Radar Screen sleeve. Reproduce the radar displays on transparent material and cut the transparent sleeve insert to size.

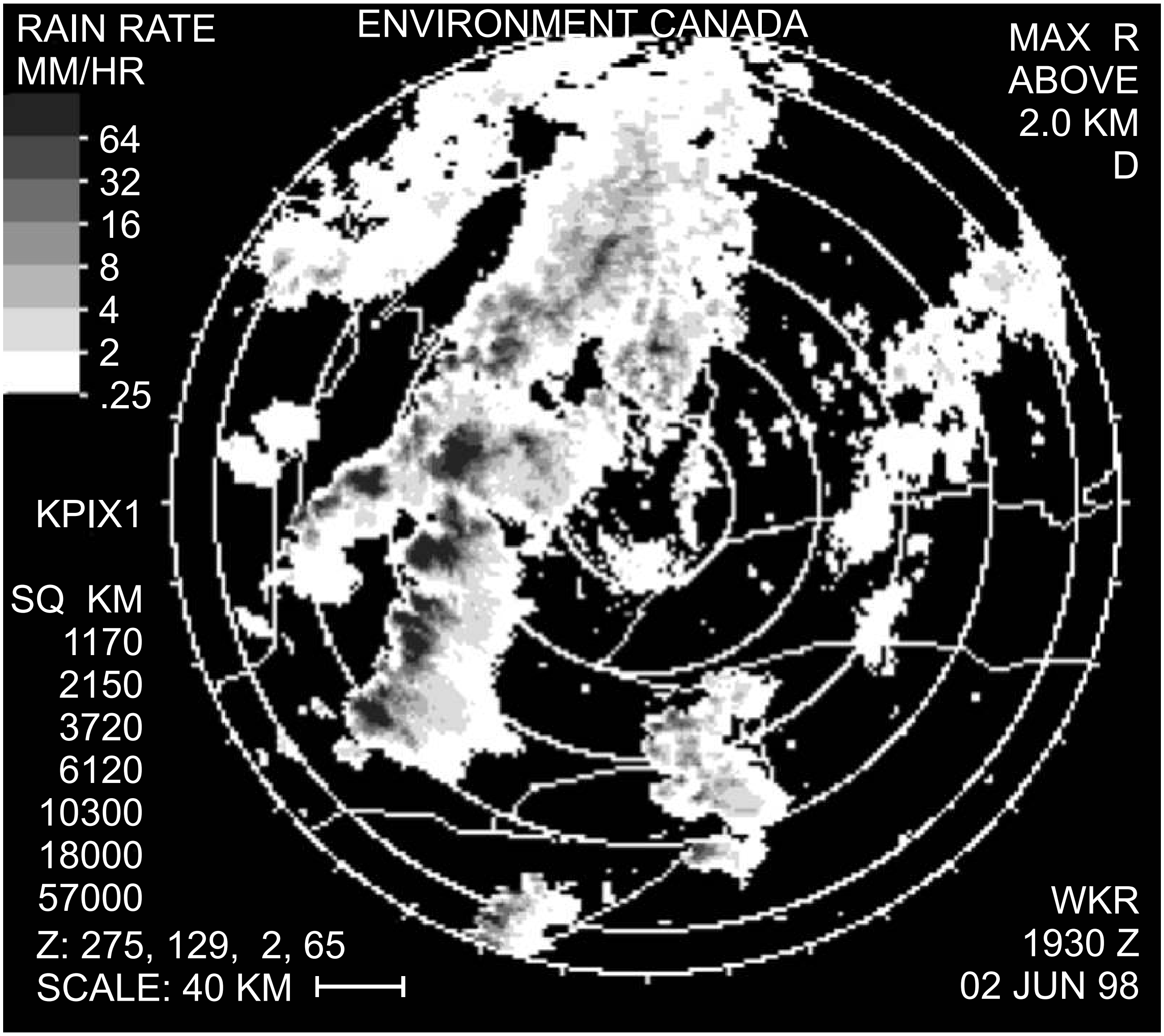
PULLER

PULLER

Cut along dotted line

DISTANCE SCALE





Environment Canada's King City weather radar located 40 km north of Toronto showing heavy precipitation echoes over southern Ontario on June 2, 1998

ACTIVITY Interpreting a Radar Precipitation Display

Upon completing this activity, you should be able to:

- Locate areas of precipitation by interpreting a radar display.
- Track and determine changes over time as precipitation echoes move through a weather radar's field of view.
- Relate the intensity of radar echoes to the areas with the greatest amount of rainfall.

Introduction

Day or night, clear or cloudy, meteorologists need to observe weather at great distances. Radar especially designed for weather observation makes it possible to locate areas of precipitation and to maintain watches on the severity of storms as weather happens.

Weather radars detect water and ice particles in and below clouds that are large enough to fall as rain, snow, or hail. Their fields of view stretch far beyond the visible horizon, sometimes showing the tops of thunderstorms 350 kilometres away. Their returned signals can be interpreted to determine how intense the precipitation is, the size and shape of the precipitation area, its development, and how fast and in what direction it is moving. In addition, a trained meteorologist can infer from the radar data the conditions that forewarn of the existence of hazardous weather such as tornadoes, heavy downpours, and hurricanes.

From the relationship between the intensity of radar echoes and the rate of rainfall, the total amount of rain at a location can be estimated by computer addition of the rainfall over a period of time. The determination of rainfall totals over an hour, several hours, or even the duration of the storm is important in judging the possibility of flash flooding in a river or stream valley. Localized heavy rainfall events, such as the Saguenay flood event, can cause significant erosion and represent a serious threat to life and property in many parts of Canada.

Method

The Radar Screen slide chart presents precipitation "Reflectivity" views at two successive times during a day when there was precipitation occurring. The irregular shapes appearing in the image represent precipitation areas. They are contoured and shaded to denote levels of intensity, which in turn are related to precipitation rates. The darkest hatched areas surrounded by the most contours indicate the most intense rainfall. The "4 p.m. Precipitation Total" is also shown for the storms up until the time of the 4 p.m. reflectivity image. Adjust the slide insert until the 3 p.m. view is centred in the Radar Screen window.

Questions

1. Look at the <u>3 p.m. Reflectivity</u> view. The location of the radar is depicted as a dot (•) in the echo shown in the lower right-hand corner. Distance can be measured in the horizontal view by the markings appearing along the boundaries of the view at 10-kilometer intervals. Find the strongest echo beyond the one immediately surrounding the radar's location. How far away and in what direction from the radar site is it? Also, how many levels of intensity does this echo contain?

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2. The centres of the more intense radar echoes are tracked by computer. The individual storm cells are given a storm identification, in this case A, B, and C. The past positions of the storm cells are denoted by dots connected with lines to the present echo location. Computer projections of future individual cell positions are given by crosses connected with lines for 15-minute time increments. In what general directions have these intense cells been moving in the previous 30 minutes? Are they projected to continue in the same direction or turn to a new direction? If so, what direction?

	Past	Future
A		
B		
C		

3. Tape a piece of tracing paper or transparency material over the Radar Screen window. Mark the radar's location and trace the outlines of each echo in the <u>3 p.m. Reflectivity</u> view. Next, pull the slide insert until the <u>4 p.m. Reflectivity</u> view is centred. Trace the 4 p.m. echoes. Have any of the echoes changed location or shape? If so, which ones? Is there any echo that did not change? If so, where it is located?

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4. Near radar sites, it is possible to get intense non-moving echoes because the radar signal is reflected from nearby stationary objects. Do any of your echoes fit this pattern, (*<u>yes or no</u>*)? If so, what is this echo called?

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5. Precipitation echoes will continue to move across the radar field of view. In the 4 p.m. view, how many levels of intensity are now contained in the most intense storm? __________. Generally, the more intense the rain or snow, the brighter the radar echo. Based upon this intensity, has the precipitation area experienced an *(increase, decrease, or no change)* in rainfall rate?

6. Note the curved feature at the southwest end of the most intense cell (located approximately in the centre of the view). The hook-like protrusion is called a "hook echo" and occurs when rain is being wrapped around a quickly rotating column of air. Name this severe weather feature. ____________________________. If you spotted this feature as a radar operator, what action would you consider taking?

7. From the projected track of the storm cells indicated in the 3 p.m. view and the current position at 4 p.m., how well do you think the computer forecast did? Explain your answer.

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8. Compare the movement of individual storm cells as compared to the entire line. Do individual cells move in the same direction as the line itself? __________. Which direction is the line moving? __________. In which general direction are the cells moving?

______________________________.

9. Finally, pull out the slide until the 4 P.m. Precipitation Total view is centred in the window. The levels shown in this image depict the total amount of precipitation (usually in millimetres) that has fallen at any location during the time echoes were detected by the radar and compiled by the computer. How do the greatest rainfall amounts compare to the most intense reflectivity echoes from the 3 and 4 p.m. views?

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10. If a hydrologic forecaster has prior knowledge of streams, local typography, and locations of homes and business areas, how would the forecaster use the rainfall total information to alert people to possible flood danger? What factors do you think are important for rainfall runoff?

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