CHAPTER 3

The Changing Weather

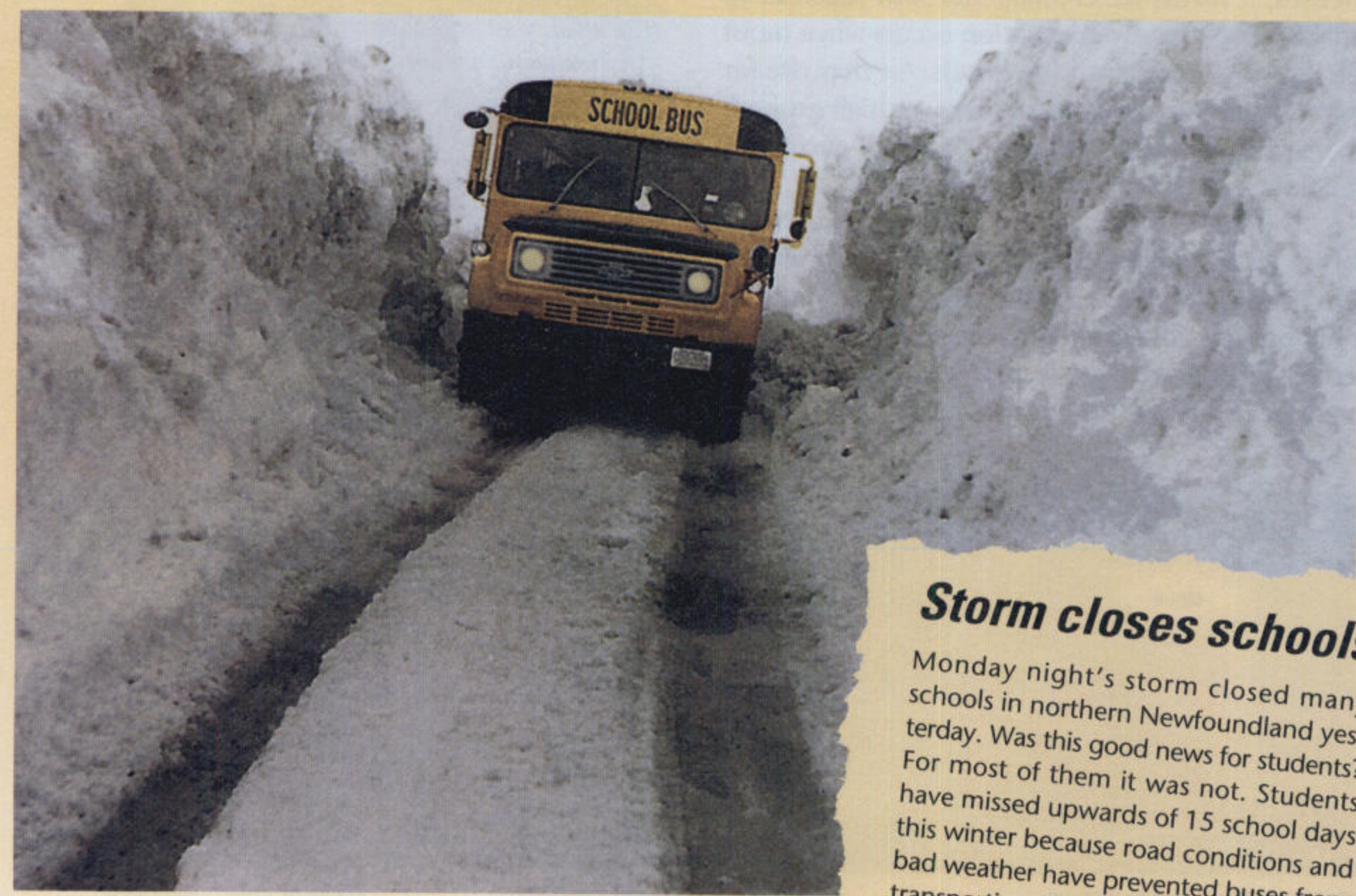


Figure 3.1 Estimate the height of the snowbanks in this picture. Based on your estimate, if 10 cm of snow melts to approximately 1 cm of water, what depth of water would this snow represent?

Storm closes schools

Monday night's storm closed many schools in northern Newfoundland yesterday. Was this good news for students? For most of them it was not. Students have missed upwards of 15 school days this winter because road conditions and bad weather have prevented buses from transporting them to school. Many high school students have been kept busy in recent weeks, copying borrowed notes, getting extra help from teachers and "cramming" at night.

Raymond Hancock has been driving a school bus in Goose Cove for nine years and he says conditions this year are the worst he's seen. "The road has been treacherous," he notes. "Crews are working as hard as they can on the road, but there is just too much snow. They can't keep up with it. It's been storm after storm. The only way to keep the road clear is to have someone working on it for 24 hours a day."

Except for the headline "School's out for the summer," the newspaper headline at right probably gets the most smiles from students. Don't give all the credit to your school principal though. He or she may make the decision to close your school if you live in a remote rural area, but it's more likely that a number of different people are involved. School district officials, road and transportation crews, and provincial weather offices will have a role to play.

- How do we examine the weather so that school district officials, and many others, can plan for its impact?
- What are the factors that affect our climate, causing a variety of weather conditions?

What Is a Snowstorm?

Two factors are essential in the creation of a snowstorm: snow and wind.

Snow

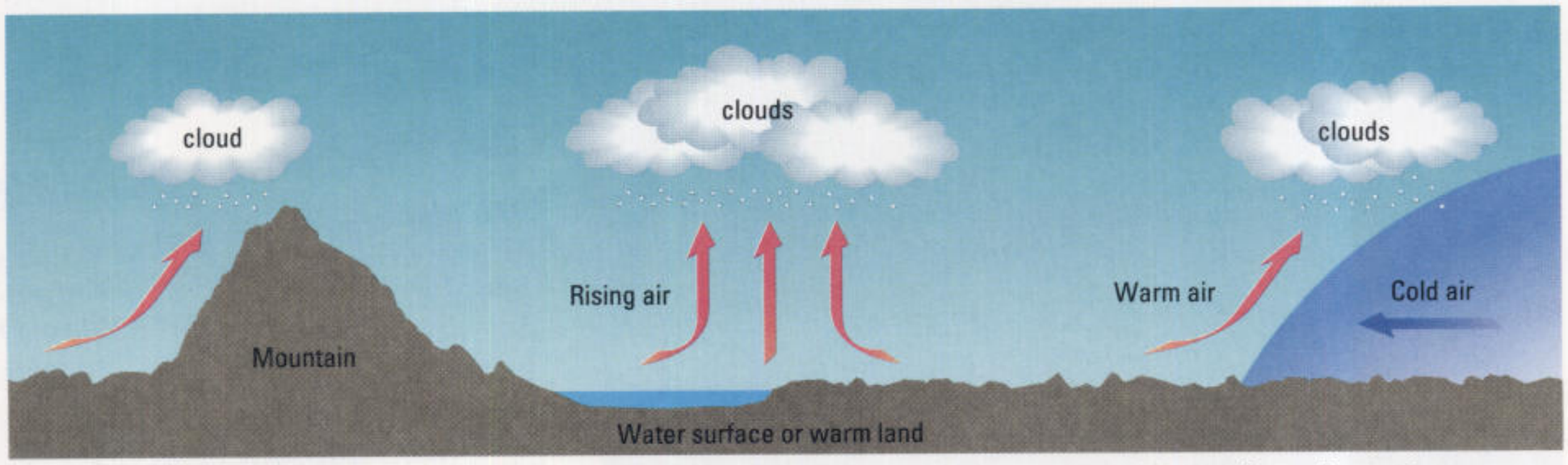
Snow forms when water vapour condenses at a temperature below the freezing point. As it condenses, it forms ice crystals that join together to make snowflakes. **Condensation** occurs when moist air rises and cools, forming clouds. Air may rise for several reasons: it may be blown over high ground, it may be warmed from below, or it may encounter a colder and denser air mass (Figure 3.2).

You might think that schools would close most often in areas with the greatest annual snowfall. On its own, however, average snowfall cannot reliably predict your days off school. Figure 3.4 was created using averages — that is, figures based on measuring snowfall over as many as 30 years.

Canadian January Night

Ice storm: the hill
a pyramid of black crystal
down which the cars
slide like phosphorescent beetles
while I, walking backwards in obedience
to the wind, am possessed
of the fearful knowledge
my compatriots share
but almost never utter:
this is a country
where a man can die
simply from being
caught outside.

Alden Nowlan



Orographic condensation: Air cools as it rises over high ground.

Convectional condensation: Air rises when warmed from below.

Frontal condensation: Warm, moist air rises over cold air.

Figure 3.2 Some conditions leading to condensation

Figure 3.3 What conditions are necessary for snow to fall?

Figure 3.4 Average annual snowfall in the Atlantic provinces, in centimetres. The areas of greatest snowfall are areas of higher ground. Snow may fall on Mount Carleton, New Brunswick (820 m high), as late as June and as early as September. Communities in northern and central Labrador, areas of fairly high elevation, often experience snowfall throughout the year.

Exceptional snowstorms can skew the figures. For instance, an area might get all the year's snow in one stormy week, or it might have an exceptionally snowy year. In the winter of 1977–78, when Woody Point, Newfoundland, received a total of 893 cm of snow, schools were closed for more days than anywhere else in Atlantic Canada.

Snow is not the only necessary ingredient in a snowstorm. You also need wind — lots of it.

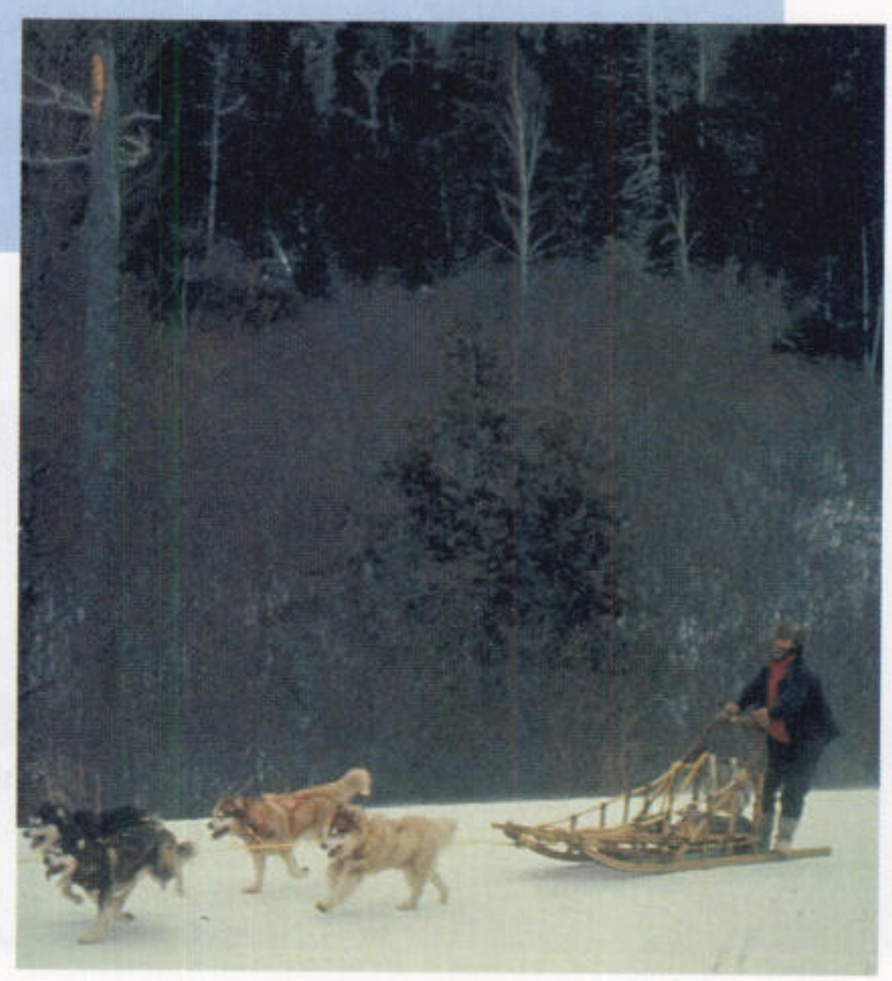


Figure 3.5 While students might suffer from the effects of the snowstorm, many people benefit. List the people and businesses for whom a snowstorm might be good news.

Wind

Snow drifting down in soft white flakes generally does not present a danger to traffic. The same snow propelled by fast-moving air, however, becomes a biting, blistering blizzard that is hazardous to most forms of transportation.

Wind is air that is moving from an area of **high pressure** to an area of **low pressure**. Remember that hot air rises and cold air sinks. A warm surface will heat the air above it, making the air rise (see Figure 3.6). This creates an area of comparatively low pressure beneath the rising air. An area of high pressure forms when cool air sinks towards the surface, pushing the air underneath away (see Figure 3.7).

Air over the North and South Poles sinks because it is cold, producing an area of high pressure. Air over the equator rises because it is hot, producing an area of low pressure. Without the rotation of the earth, air would travel ceaselessly up and down from the poles to the equator. However, the earth does rotate on its axis once every day, so that a point on the equator travels approximately 40 000 km in 24 hours — a velocity of nearly 1700 km/h. Even a point on latitude 46°N (close to Moncton, New Brunswick; Charlottetown, Prince Edward Island; and Sydney, Nova Scotia) travels at over 1150 km/h. As a consequence, winds in the northern hemisphere blow counterclockwise into a low pressure area and clockwise out of a high pressure area. An area between high and low pressure feels the effects of both circulations (see Figure 3.8). High winds can develop when areas of very high and very low pressure come close together.

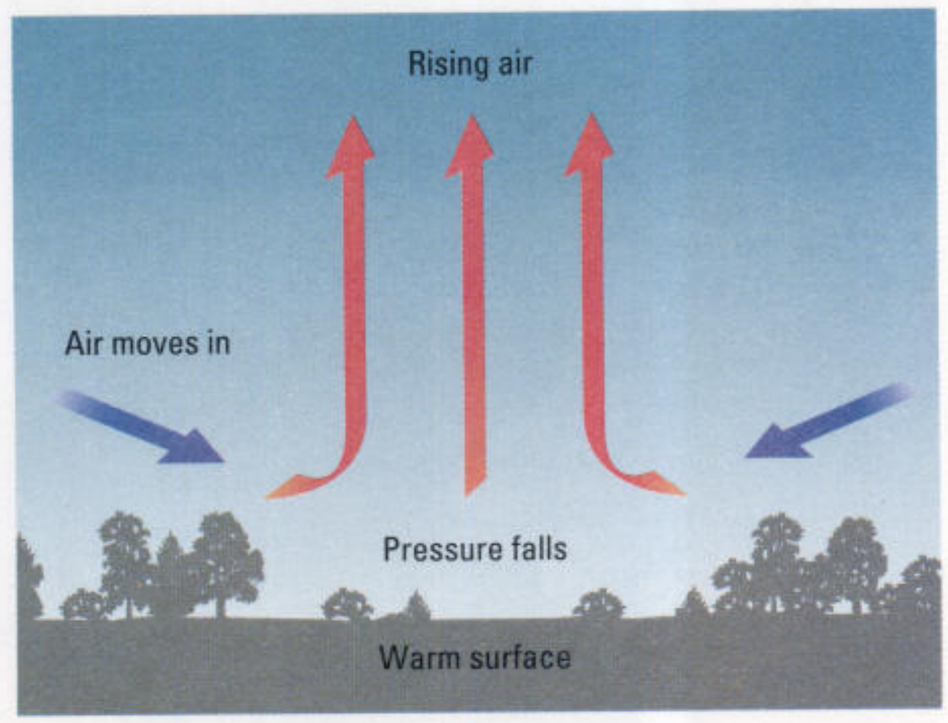


Figure 3.6 Air rising over a warm surface; a low pressure area

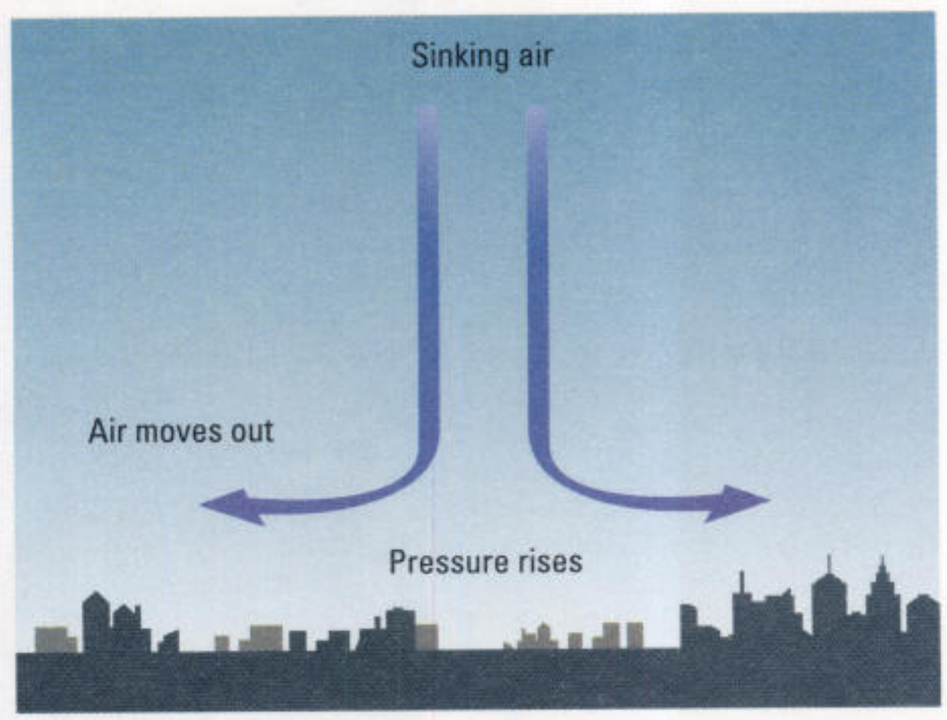


Figure 3.7 Cool air sinking; a high pressure area

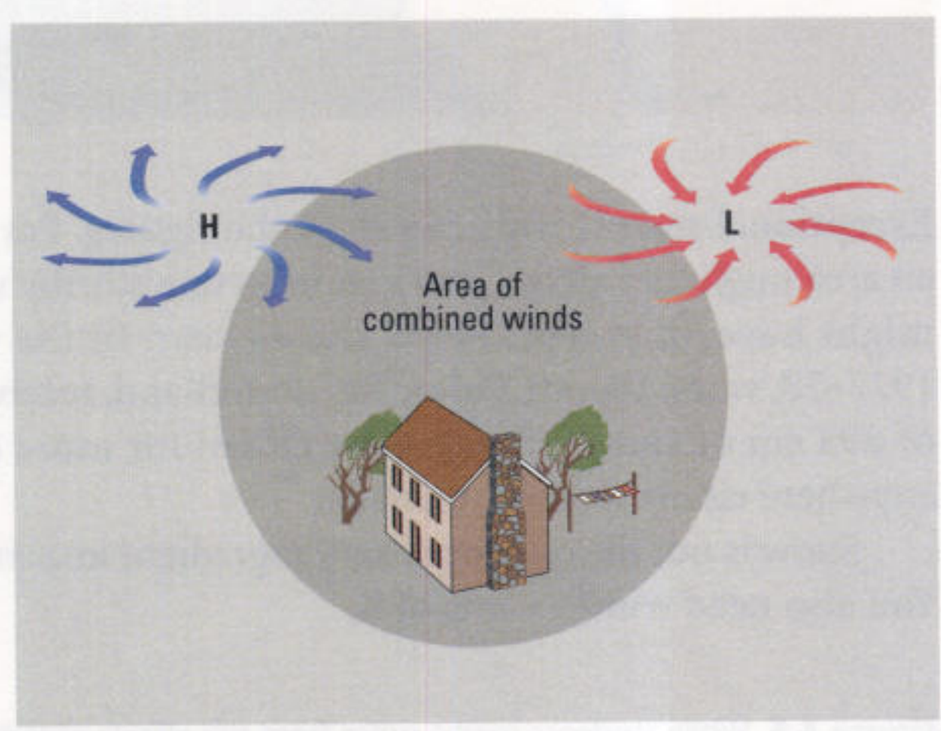


Figure 3.8 High winds can develop between areas of high and low pressure.

DID YOU KNOW...?

Wind can be used as a source of energy. The Atlantic Wind Test Site at North Cape, Prince Edward Island, develops and tests wind energy equipment. Windmills are used to drive turbines and generate electricity. Some of the electricity can be stored in batteries for times when there is little wind.

EXPLORATIONS

REVIEWING THE IDEAS

1. Compare the relief map of Atlantic Canada in Figure 2.2 (page 19) with Figure 3.4. What patterns do you see when you compare elevation and annual snowfall?

APPLYING YOUR SKILLS

2. **a)** Draw a diagram of a globe to show what the general flow of winds would be if the earth did not rotate.

   b) Use an atlas to find a map of world winds. Draw a diagram of a globe showing the actual general flows of the winds of the earth.

ANALYZING AND REFLECTING

3. Discuss the possible positive and negative impact of snow on an area.

CONNECTING AND EXTENDING

4. **a)** Work with a partner. Practise reading the poem "Canadian January Night" aloud.

   b) Which sounds are repeated often in the poem? How do these sounds relate to the topic of the poem? What effect do they create?

   c) Do you agree with Alden Nowlan's view of winter? Describe your own response to winter. You may wish to present your ideas in the form of a poem, painting, or collage.

FACTORS AFFECTING THE CLIMATE OF ATLANTIC CANADA

Of course there is more to the climate of Canada than just snow. **Climate** refers to the average conditions of temperature, **precipitation** (rain, snow, and any other forms of water particles that fall from the atmosphere), humidity, pressure, and wind. The climate of the Atlantic provinces is usually humid and relatively cool. At times, however, there are floods, droughts, cold snaps, or heat waves. These extreme conditions are averaged with other recorded figures to determine the climate, but they are also part of the region's ever-changing **weather** — that is the conditions of the atmosphere over a short period.

A number of factors influence the climate of Atlantic Canada. These include latitude, air masses, ocean currents, and proximity to water.

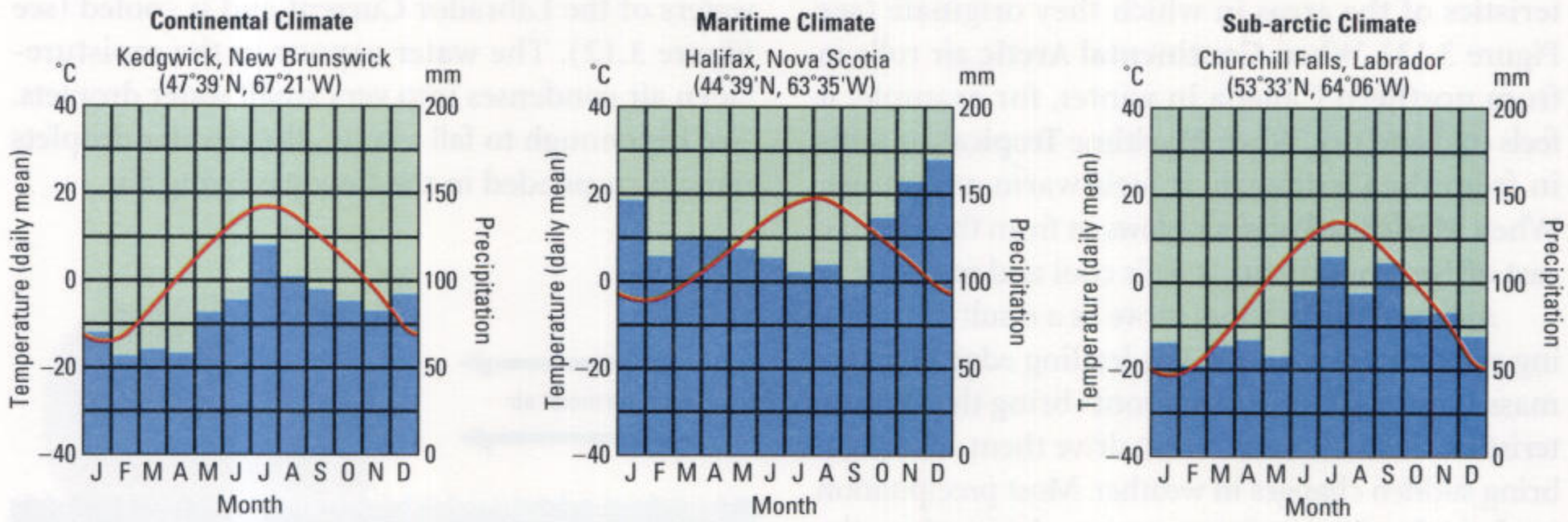


Figure 3.9 Three main climate types in Atlantic Canada. The numbers on the left of each graph and the red lines show temperature. The numbers on the right and the blue bars show precipitation. Write a description of each of the climate types shown, drawing generalizations from the information in the graphs. What is the climate type where you live?

Latitude

All parts of the world receive the same total number of hours of daylight in the course of a year. Because the earth's surface is curved, however, sunshine is more intense in lower latitudes (see Figure 3.10). Thus Cape Sable, Nova Scotia, at latitude 43°N, receives more intense sunshine than Belle Isle, Newfoundland, at 52°N, or Killinek Island, Labrador, at 60°N.

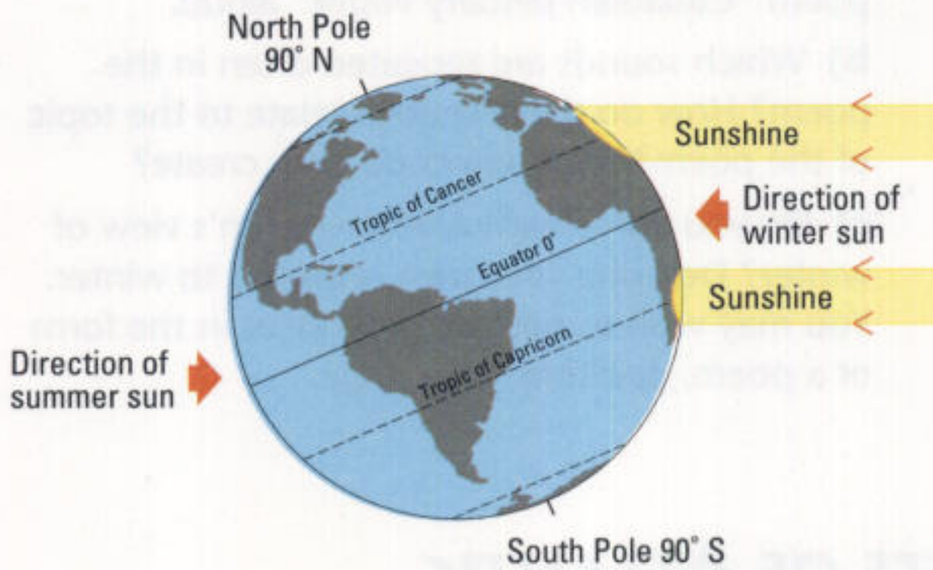


Figure 3.10 Intensity of sunshine varies with latitude. Because the earth is tilted on its axis, sunshine also varies with the seasons. Use a piece of curved black cardboard and a flashlight to show how the intensity of sunshine varies with latitude. How does intensity vary in northern regions in winter and summer?

Air Masses

Large volumes of air with similar temperature and moisture conditions throughout are called **air masses**. Wind is the movement of the air within these masses. Air masses affect the climate because they take on the temperature and humidity characteristics of the areas in which they originate (see Figure 3.13). When **Continental Arctic** air rolls in from northern Canada in winter, for example, it feels cold and dry. When **Maritime Tropical** air wafts in from the Caribbean, it feels warm and moist. When **Maritime Polar** air blows in from the Atlantic east of Newfoundland, it feels cool and moist.

Air masses, like wind, move as a result of changing pressure conditions. The leading edge of an air mass is known as a **front**. Fronts bring the characteristics of the air masses that drive them, and often bring sudden changes in weather. Most precipitation in the Atlantic provinces comes about when the cold and dry air masses from the north meet the warm and moist air masses from the south.

Figure 3.11 These teenagers at Covehead Beach, Prince Edward Island, are enjoying the summer sunshine. What should they do to protect themselves from the harmful ultraviolet rays, which are more intense at this time of year?

Ocean Currents

Just as air masses coming from distant places affect our climate, so do **ocean currents**. The waters of the world's oceans are constantly in motion. Tides move the water up and down while currents move water from place to place. The major ocean currents have considerable influence on climate. The **Gulf Stream**, an ocean current from the south, brings warmth to the southeastern waters of the Atlantic provinces. **The Labrador Current**, flowing from the north, brings cold waters to much of the Atlantic coast. The Gulf Stream warms and moistens the air masses above it, while the Labrador Current cools and moistens.

Fog is a common phenomenon along the Atlantic coast. It often forms when the warm moist air over the Gulf Stream waters moves over the waters of the Labrador Current and is cooled (see Figure 3.12). The water vapour in the moisture-laden air condenses into very small water droplets. Not big enough to fall as rain, these water droplets remain suspended in the slowly moving air.

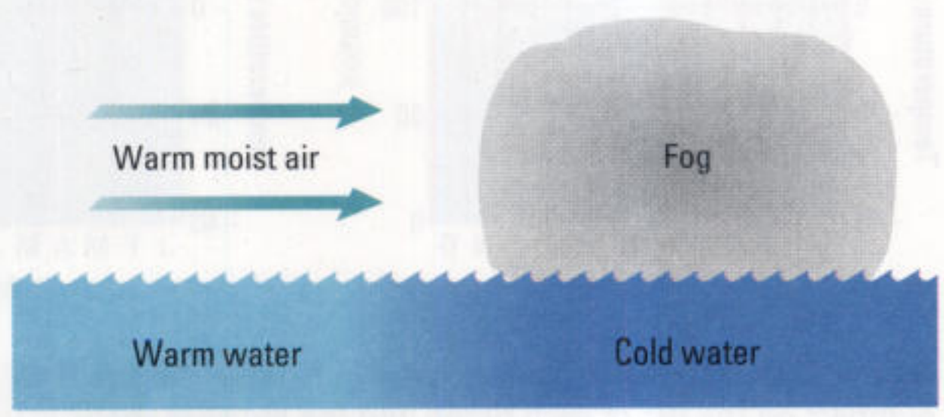


Figure 3.12 Formation of fog

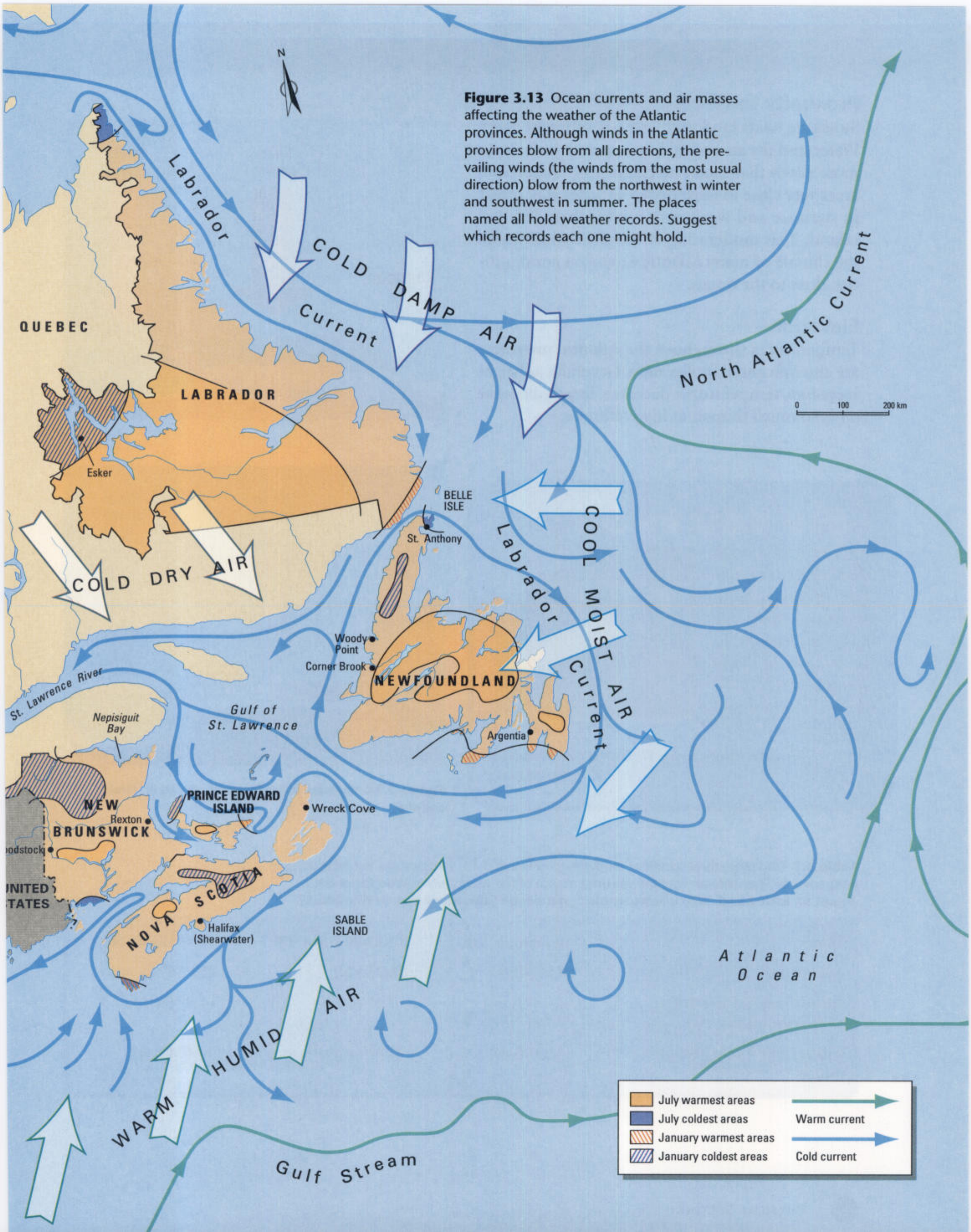


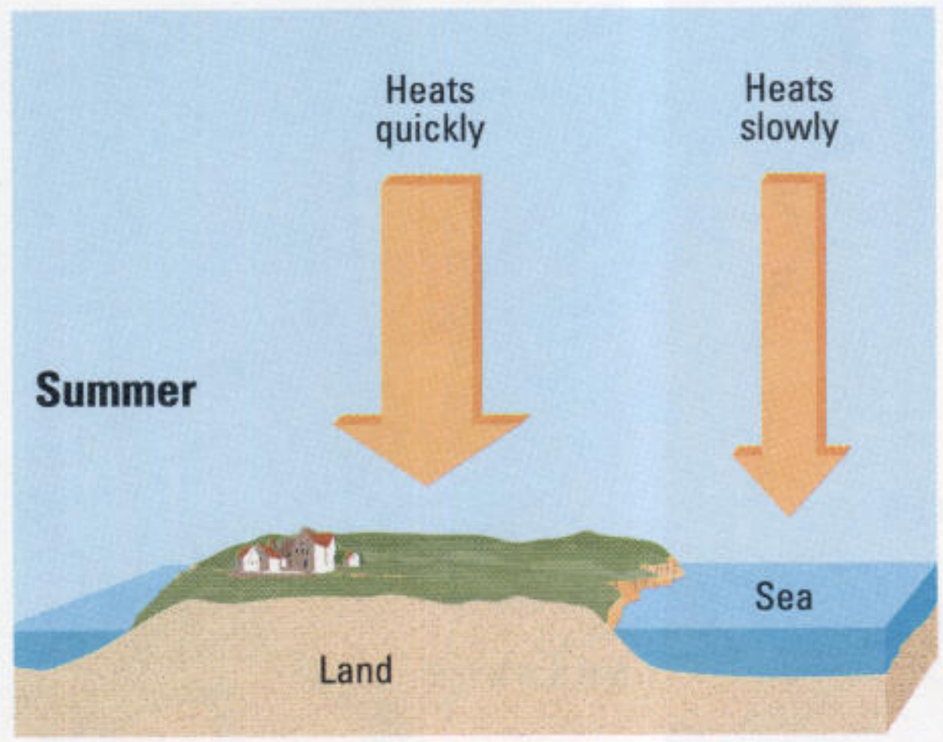
Figure 3.13 Ocean currents and air masses affecting the weather of the Atlantic provinces. Although winds in the Atlantic provinces blow from all directions, the prevailing winds (the winds from the most usual direction) blow from the northwest in winter and southwest in summer. The places named all hold weather records. Suggest which records each one might hold.

Proximity to Water

Sunshine heats land and water at different rates. Water, and the air over it, heats up and cools down more slowly than land (see Figure 3.14). As a result, areas very close to large bodies of water stay cooler in summer and warmer in winter than do areas inland. This moderating effect greatly influences the climate of many Atlantic Canadian communities close to the ocean.

Elevation

Temperatures throughout the Atlantic provinces are also influenced by elevation. Generally, as height increases, temperatures decrease, largely because air is so much thinner at high altitudes.



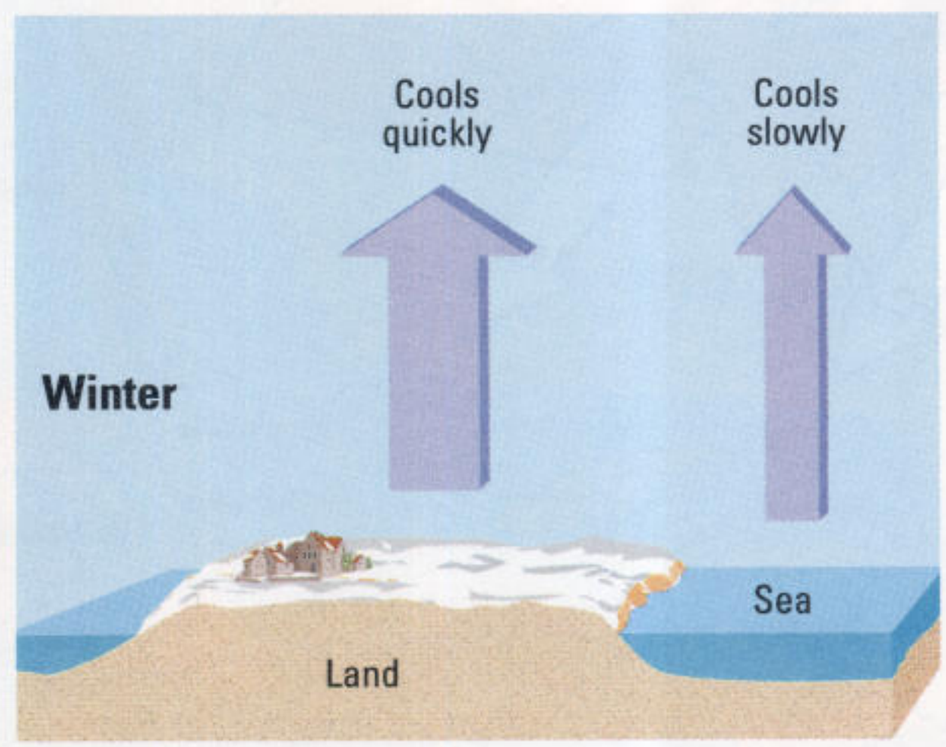


Figure 3.14 Variation in heating and cooling on land and sea

DID YOU KNOW...?

Our climate has sparked some remarkable inventions: the snowblower, snowplough, frozen fish, insulation, underground shopping malls, winter fuels and lubricants, the kerosene foghorn and all-weather asphalt.

Source: Environment Canada, The Climate: What a Difference a Degree Makes.

Table 3.1 Find these three locations on the map in Figure 3.13. What causes the differences in temperature? Speculate on why the warmest month of the year is July in Woodstock but August on Sable Island. Why is February much warmer on Sable Island than in Woodstock?

Place	Woodstock, NB	Charlottetown, PEI	Sable Island, NS
Location	(46°09′N)	(46°15′N)	(43°56′N)
Mean Daily Temperature (Coldest month)	–11.5° (Jan.)	–7.5° (Feb.)	–1.3° (Feb.)
Mean Daily Temperature (Warmest month)	19.3° (July)	18.8° (July)	17.6° (Aug.)

FOCUS ON AN ISSUE

World Climate Change

In recent years, scientists have warned that the earth's atmosphere is being altered by gases produced through various human activities. These gases, many say, are producing a "greenhouse effect." The earth absorbs much of the sun's radiation, but some is reflected back into the atmosphere. The "greenhouse gases" in the atmosphere absorb or trap some of this radiation, rather than allowing it to escape to the upper atmosphere. The result is a change in temperature that threatens to alter the climate around the world. In some parts of the world, temperatures have increased over the last 50 years. In others, including the Atlantic provinces, the average temperature decreased over the same period. The gases primarily responsible for this climate change are carbon dioxide, nitrous oxide, and methane.

Climate Change: A Canadian Concern

Carbon dioxide (CO^2) accounts for 80% of Canada's total greenhouse gas emissions. The majority of CO^2 results from burning fossil fuels for energy. This means that when we use energy — whether driving our car, using the clothes dryer, watching television or leaving the lights on — we are usually burning fossil fuels and contributing to the problem of climate change. It also means that when we choose to ride our bike, hang our clothes to air dry, read a book or turn off the lights when we leave the room, we are directly contributing to a solution to climate change.

Methane and nitrous oxides make up the remainder of Canada's greenhouse gas emissions. Sources include landfills, agricultural practices, chemical processes and fertilizer production and consumption. We can reduce the emissions of methane and nitrous oxides to the environment by reducing the amount of waste we generate by composting, recycling and, most importantly, reducing our consumption of disposable items.

Source: Pollution Probe, ProbeAbilities: A Report to Pollution Probe Members, *Fall 1996.*

Figure 3.15 Mean annual temperature change from 1930–59 to 1960–89, as calculated in 1995. Note that temperatures need to be collected over long periods of time to establish changing patterns.

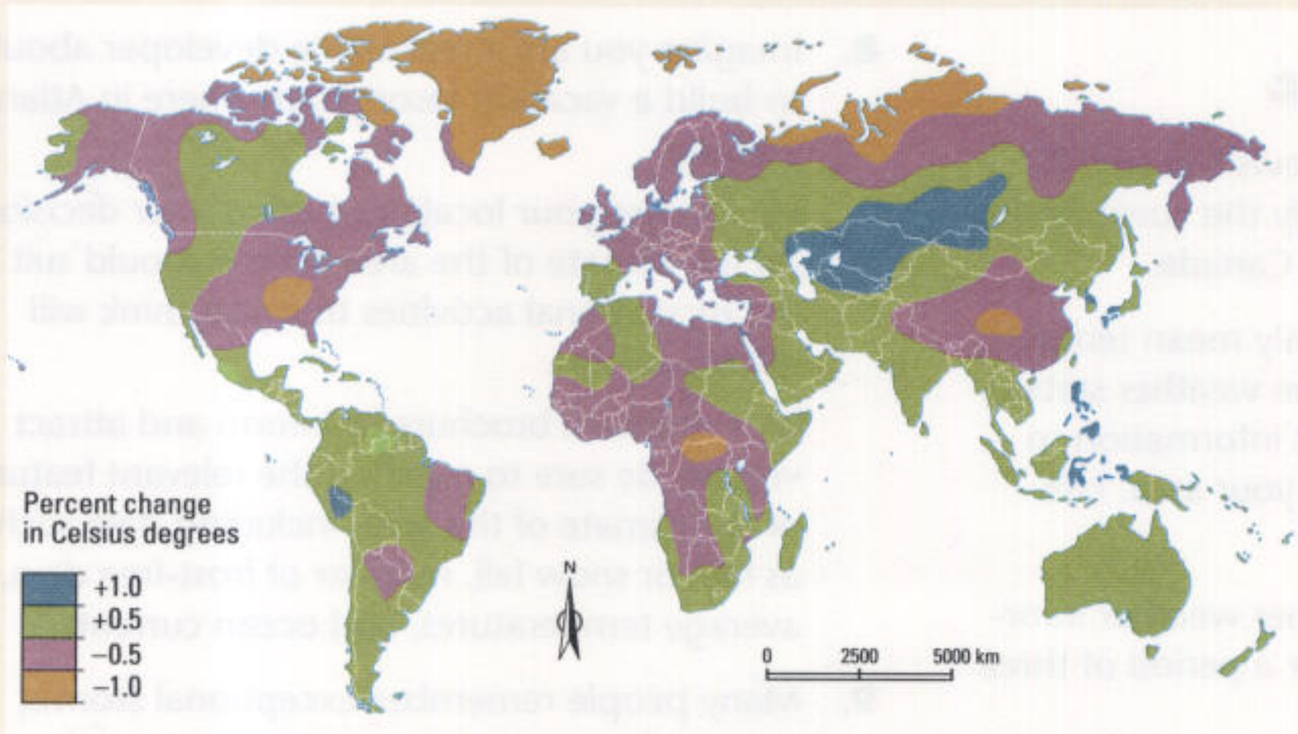


Table 3.2 Top producers of greenhouse gases

Country	Percent of global emissions
United States	18.4
Former U.S.S.R.	13.5
China	8.4
Japan	5.6
Brazil	3.6
Germany	3.6
India	3.5
United Kingdom	2.4
Mexico	2.0
Italy	1.8
France	1.7
Canada	1.7

ANALYZING THE ISSUE

1. Work in a small group to discuss these questions.

   a) How do you, personally, contribute to climate change?

   b) Environmentalists encourage us to "think globally, act locally." How is this view reflected in the article?

   c) Many environmentalists also believe that the problem of climate change can be controlled only through international cooperation. Why is this so?

2. Write a "letter to the editor" or make a poster to encourage one way of addressing the problem of climate change.

EXPLORATIONS

REVIEWING THE IDEAS

1. **a)** In what way are ocean currents and air masses similar?

b) Which one has an effect that is less immediate but longer lasting? Explain.

APPLYING YOUR SKILLS

2. Give reasons why the locations identified in Figure 3.13 are the warmest or coldest areas of each region in January and July.

3. In terms of location, explain why these Atlantic records do not surprise you.

a) The record highest temperature occurred at Woodstock, New Brunswick.

b) The record lowest temperature occurred at Esker, Labrador.

c) The record number of frost-free days occurred at Sable Island, Nova Scotia.

d) The record number of foggy days occurred at Argentia, Newfoundland.

CONNECTING AND EXTENDING

4. Look at a world map that shows the world's major ocean currents. Identify the currents that affect the climate of Atlantic Canada.

5. Obtain information of monthly mean temperatures and precipitation for the weather station nearest your school. Plot this information to produce a climate graph for your area. Use Figure 3.9 as a model.

6. Work in small groups to gather weather information for your local area for a period of three weeks.

a) Use your own observations or local weather reports. Each member of the group should focus on one of the items below and record information for:

i) temperature (maximum and minimum)
ii) wind (direction and strength)
iii) amount of cloud cover
iv) precipitation (type and duration)

b) Combine your information to make a chart of the weather over the three-week period.

c) What connections can you see among temperature, wind, cloud, and precipitation?

7. Work in a small group.

a) Each student should choose one of the groups below. Do some research to find out the way in which climate affects how these people make a living, which seasons they work, and where in the province they tend to live. Also consider how they adapt their work to the climate.

- potato farmers in Prince Edward Island
- loggers in New Brunswick
- crab fishers in Newfoundland
- fur trappers in Labrador
- fruit growers in Nova Scotia

b) Organize your findings in a chart entitled "Effects of Climate on the Atlantic Way of Life."

8. Imagine you are a real-estate developer about to build a vacation resort somewhere in Atlantic Canada.

a) Choose your location, basing your decision on the climate of the area, which should suit the recreational activities that you think will attract visitors.

b) Produce a brochure to inform and attract visitors. Be sure to mention the relevant features of the climate of the area, including data such as rain or snow fall, number of frost-free days, average temperatures, and ocean currents.

9. Many people remember exceptional storms, extremely warm summers, or other weather events. Interview someone in your community about an outstanding weather event that he or she remembers. Write an account of this event. You might wish to use journalistic style or a short story format.

Examining Weather

From Land and Sea

Scattered throughout Atlantic Canada, weather observers note and transmit information about the state of the atmosphere at their particular locations. They use a variety of instruments to measure pressure, temperature, humidity, wind speed and direction, precipitation, and clouds.

Figure 3.16 Surface weather instruments, including a sunshine recorder (left), wind-speed and direction recorders (the poles with revolving cups), and Stevenson screens (the white boxes), which hold maximum and minimum thermometers

From the Air

Weather radar stations are located at Halifax, Nova Scotia; Holyrood, near St. John's, Newfoundland; and Mechanic Settlement, near Sussex, New Brunswick. Radar is especially useful in detecting, locating, and measuring the amount of precipitation in clouds.

From Space

Weather satellites travel far above the earth, in the outer atmosphere. At regular intervals these satellites take pictures of the earth's surface and transmit them to weather stations on the ground. **Meteorologists**, or weather experts, use these images to make long-term weather forecasts.

Figure 3.18 (on page 44) shows an image taken by a weather satellite at 2:45 p.m. Atlantic Standard Time on March 2, 1996. It shows a winter storm approaching the Atlantic provinces. Later that day, this storm dumped more than 30 cm of snow over much of the western areas of the Atlantic provinces, while the eastern shore of Nova Scotia experienced snow followed by rain. On the following day, Newfoundland experienced considerable snowfall. A meteorologist used a series of satellite images together with information from other sources to produce the weather map shown in Figure 3.19. This map shows the weather of the same area shown in the satellite image for exactly 2:00 p.m. on the same day. By using several sources of information, the meteorologist could make a dependable long-term forecast about where this storm was going. This information would have been used to prepare weather reports, warning you to prepare for snow if you were venturing out for the afternoon.

Figure 3.17 A weather radar station

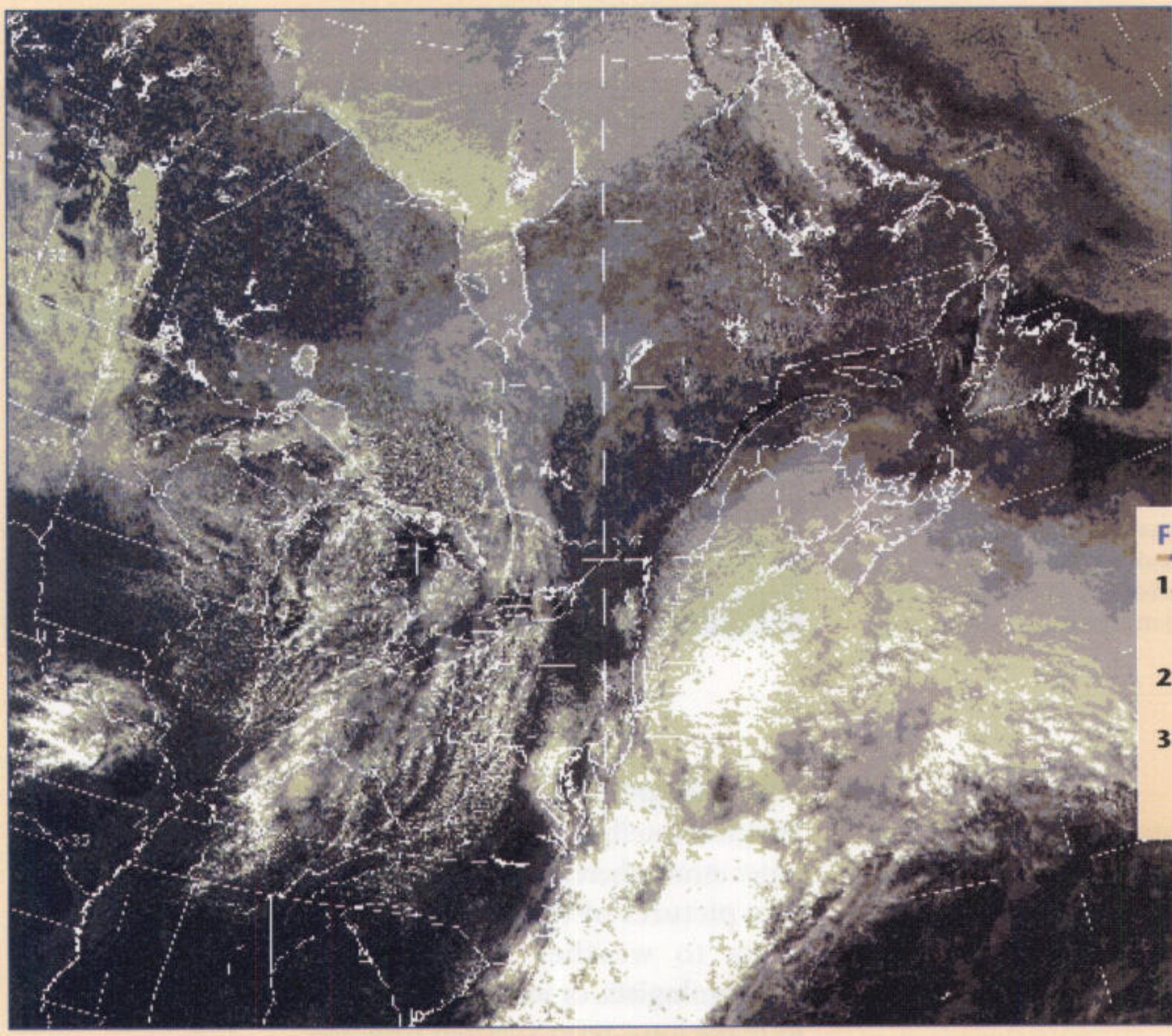


Figure 3.18 Satellite image of winter storm at 2:45 p.m. on March 2, 1996.

FOCUS ON FIGURE 3.18

1. Describe the shape of the cloud shown in the southeastern portion of the image.
2. Describe the relative position of the storm.
3. Using Figure 3.19, state the absolute location of the centre of low pressure.

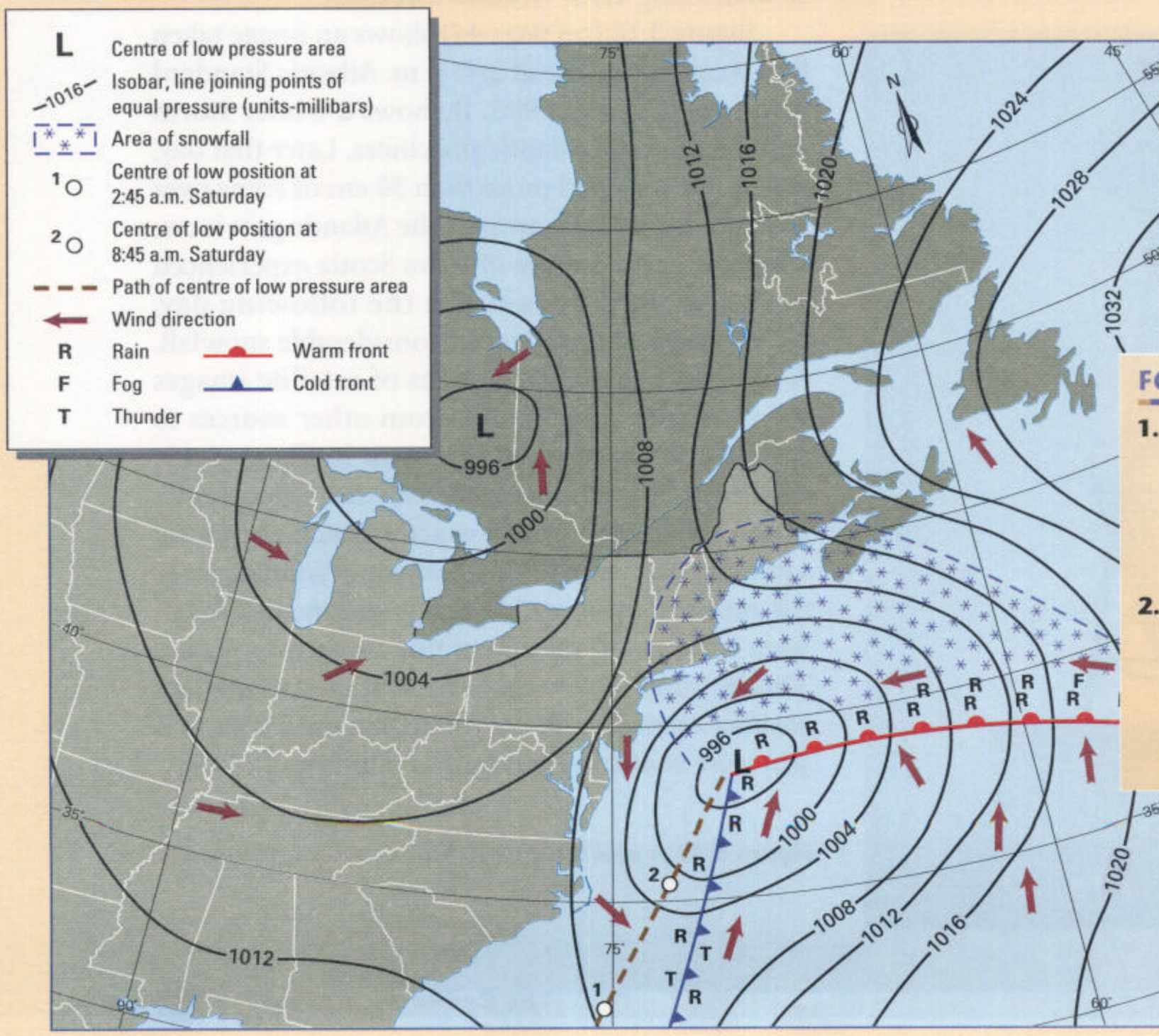


Figure 3.19 Simplified weather map of the area of the satellite image above, showing the weather at 2:00 p.m. on the same day

FOCUS ON FIGURE 3.19

1. Assuming the storm continues on the path shown, how long will it take for the centre of low pressure to reach
   - Prince Edward Island?
   - Labrador?
2. At what time can snow be expected to start falling at
   - Charlottetown, Prince Edward Island?
   - St. John's, Newfoundland?
   - your school?

Career Focus: Meet a Meteorological Technician

Charlie Kennedy is an armed forces meteorological technician who works at the weather office at Canadian Forces Base Gagetown, New Brunswick. He studied mathematics, science, and computers as part of his training.

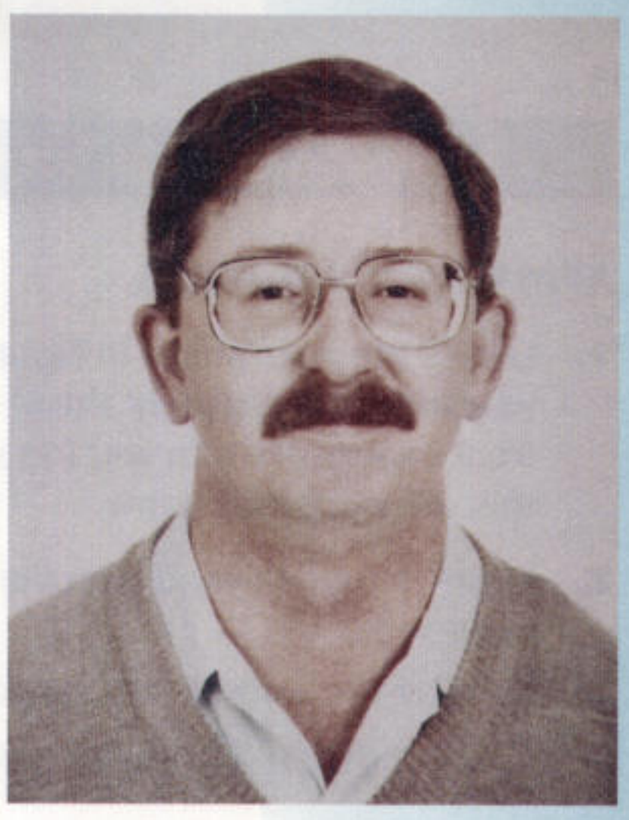


Figure 3.20 Charlie Kennedy, meteorological technician

Q: What do meteorological technicians do?

A: Generally speaking, we study the atmosphere. We examine changes in air pressure and temperature, movement of air masses, and vertical differences in the atmosphere. Most people think of meteorologists as weather forecasters. In fact there are many opportunities for meteorological technicians — in areas such as forestry, aviation services, mining companies, oil rigs, and the armed forces.

Q: What are your main duties here at Base Gagetown?

A: The meteorological unit provides information to the artillery for two purposes. First, atmospheric conditions affect the movement of shells. A shell fired a distance of 10 km may miss the intended target by as much as 1000 m if atmospheric conditions such as wind, humidity, and air pressure are not taken into account. Secondly, we provide a Fire Weather Index, which is based on air temperature, humidity, wind speed and direction, atmospheric pressure, precipitation, and underground temperatures (from sensors buried beneath the surface at 10 and 90 cm). This information helps to determine the danger of fires starting as a result of exploding shells.

Q: What major changes have taken place in your work during the last 15 years?

A: We used to collect and plot weather information. These were dull and tedious tasks; now they are handled by technology. Sensor information is fed directly into computers that in turn produce maps of current weather conditions and even maps of likely future conditions. It's a challenge now to keep up with the changes in the techniques used to gather information and to produce accurate forecasts.

Q: Which work experiences stand out in your mind?

A: While I was serving as a weather officer on the destroyer *HMCS Nipigon* in March 1993, we were hit by the "Storm of the Century." This storm dropped 3 m of snow on much of the New England coast and 1.5 m of snow on the Atlantic provinces.Winds of nearly 200 km/h produced a wave more than 25 m high, which caused the mast to move 54 degrees from the vertical. Several people had broken bones and there was havoc in the kitchen.

Another time we were sailing south of Newfoundland when freezing spray built up ice on the boat's superstructure — its surface above the main deck — to a thickness of 45 cm. Too much ice will make a ship top heavy and very unstable, so we spent 18 hours cutting at the ice with axes. The captain asked where he would find warm air, and I was able to advise St. Mary's Bay or the Gulf Stream waters. We sailed to St. Mary's Bay and the ice melted.

Q: Why do meteorologists and other weather forecasters sometimes "get it wrong"?

A: It is true that the weather we forecast does not always happen! There are so many factors to be taken into account when trying to predict upcoming weather. We have pictures of past and present weather based on information from weather stations across the land and sea, and we use computer models that show what is likely to happen, but we have to account for another dimension: time.

Making predictions is somewhat like trying to play a game of chess in which all the pieces are moving while you are planning your next move. As technology improves, our forecasts will become more reliable. We will also be able to provide a greater variety of weather information, such as information for travellers and tourists, a UV radiation index, beach forecasts in summer, and ski conditions in winter.

EXPLORATIONS

APPLYING YOUR SKILLS

1. Locate the warm front in Figure 3.18. Suggest why areas immediately ahead of the warm front experience rain and fog while areas farther ahead receive snow.

2. What change in wind direction may be expected
   a) after the warm front has passed?
   b) after the cold front has passed?

CONNECTING AND EXTENDING

3. Work with a partner.
   a) Check your local newspaper for a weather map and a short- and long-range weather forecast.
   b) Use this information to write tomorrow's weather forecast for broadcast on television. Refer to the weather map. If possible, present the forecast to the class, using a projection of the weather map. You may even wish to make a video tape of your presentation.

4. Speculate why each of the following operations would require the services of a meteorologist.
   - the armed services
   - ministry of the environment
   - forestry company
   - airline
   - mining company in northern Canada
   - company with oil rigs off the Atlantic Coast
   - shipping company
   - ministry of tourism

CASE STUDY

THE FLIGHT OF A RADIOSONDE

Some weather stations, especially those at airports, use radiosondes to gather information about weather conditions. A **radiosonde** is a specialized piece of equipment that is carried into the atmosphere by a small balloon. In a highly coordinated effort, meteorologists all over the world send up radiosondes twice each day at exactly the same time.

The radiosonde is invaluable to weather experts because it transmits hard-to-get information about the upper atmosphere. It collects data such as temperature, relative humidity, pressure, elevation, wind direction, and wind speed that can be used to produce upper-air weather charts. The radiosonde transmits data continuously for about one hour. Later, the balloon bursts in the upper atmosphere, a parachute opens automatically, and the radiosonde falls gently to the ground.

Figure 3.21 Launching a helium-filled balloon ready to lift a radiosonde, at CFB Gagetown

1	2	3	4	5	6	7	8	9	10
Time	**AscRate**	**Ht/MSL**	**Pressure**	**Temp**	**RH**	**Dewp**	**Dir**	**Speed**	**WndStat**
min s	m/s	m	hPa	degC	%	degC	deg	m/s	
0 0	0.0	51	1001.3	11.2	95	10.4	350	2.5	———
0 30	4.4	184	985.4	10.5	89	8.8	13	7.9	ABCD–F
1 0	4.3	312	970.4	9.5	89	7.8	9	11.0	ABCD–F
1 30	4.3	441	955.3	8.7	91	7.3	4	12.4	ABCD–F
2 0	4.4	572	940.3	8.0	92	6.8	1	12.8	ABCD–F
2 30	4.3	701	925.7	7.4	94	6.5	356	13.0	ABCD–F
3 0	4.8	844	909.8	7.0	98	6.7	350	13.6	ABCD–F
3 30	4.6	981	894.8	6.5	99	6.4	340	14.9	ABCD–FG
4 0	4.6	1119	879.9	5.7	98	5.4	335	17.0	ABCD–FG
4 30	5.0	1269	863.9	4.9	98	4.6	333	18.7	ABCD–FG
5 0	5.4	1432	846.8	4.0	98	3.7	333	20.1	ABCD–FG
5 30	5.7	1603	829.2	3.0	98	2.7	337	21.6	ABCD–FG
6 0	5.8	1777	811.6	1.8	97	1.4	341	22.5	ABCD–F
6 30	6.0	1956	793.7	0.7	97	0.3	344	23.1	ABCD–F
7 0	5.9	2134	776.3	–0.3	97	–0.7	344	23.6	ABCD–F
7 30	5.0	2285	761.8	–1.1	98	–1.4	344	24.3	ABCD–FG
8 0	5.5	2450	746.2	–1.9	98	–2.2	346	25.3	ABCD–F

Column 1: Time from release of radiosonde in minutes and seconds.

Column 2: Rate of ascent in metres per second

Column 3: Height above mean sea level in metres (Note: Gagetown is 51 m above mean sea level).

Column 4: Atmospheric pressure in hectopascals (hPa). 1001.3 hPa is equivalent to 100.13 kilopascals (kPa).

Column 5: Temperature in degrees Celsius.

Column 6: Relative humidity as a percentage; the ratio of the amount of water present in the air to the amount of water vapour the air can hold at that temperature, multiplied by 100.

Column 7: Dew point; the temperature to which air has to be cooled to become saturated (incapable of holding more water).

Column 8: Wind direction in degrees based on a circle (360°). Thus a north wind would be blowing from 360 or 0, a southerly wind from 180, an easterly wind from 90.

Column 9: Wind speed in m/sec.

Column 10: The number of satellites being used to determine the position of the radiosonde. ABCD = 4, ABCD–FG = 6, A–CD–FG = 5. (A system of satellites similar to the GPS, as described in Chapter 1, is used.)

Table 3.3 Selected data collected during a radiosonde flight from CFB Gagetown, New Brunswick

EXPLORATIONS

APPLYING YOUR SKILLS

1. Refer to Table 3.3.

   a) Does atmospheric pressure rise or fall as the balloon rises?

   b) Does temperature rise or fall as the balloon rises?

2. **a)** At what height is the temperature 3°C?

   b) How long did it take for the balloon, after it was released, to reach this height?

3. What might occur if the air temperature and the dew point temperature were the same?

4. What direction is the wind coming from at the height of 572 m/MSL?

5. What happens to the speed of the wind as the radiosonde travels from the surface up to 2450 m/MSL?

6. Imagine you were flying a kite at Base Gagetown when the radiosonde was released. In which compass direction would you look to see your kite if it were 521 m above the surface of the ground? Remember that the wind direction in the chart indicates where the wind comes from.

7. What causes the helium balloon to burst?

CONNECTING AND EXTENDING

8. List all the kinds of information a radiosonde communicates. What course in school would help you interpret the information provided by a radiosonde?

SEEING THE BIG PICTURE

Work in groups to speculate on the possible effects of climate change.

1. Prepare an illustrated report or display showing the possible benefits or harmful effects of climate change in the Atlantic provinces. Take into account the impact of increasing and decreasing temperatures. How might sea levels, rainfall, and storm activity be affected? Each group member should choose a different topic from the following list, and then contribute his or her findings to the group project.
   a) agriculture
   b) fishing
   c) forestry
   d) tourism and recreation
   e) transportation
   f) home construction
   g) clothing

2. On an outline map of the world, and with reference to an atlas, show some fundamental changes that might occur in other areas as a result of climate change. Assume that temperatures will continue to change as shown in Figure 3.15. Each student should choose one of the following climate zones and speculate on changes that should be shown on the map.
   a) tropical climates
   b) arid climates
   c) warm humid climates
   d) polar climates
   e) mountain climates