## Chapter 4 Weather and Climate

Canada's vast size creates a diverse range of weather conditions and climatic conditions.

Weather examples:	Rainy today
	Snow tomorrow
	Fog on Wednesday
	23 degree C today
	High winds for this afternoon

Climate examples:	Snowy winter
	Warming trend for last 10 years
	Wet Spring
	Dry five summers

Meteorologist: A scientist who studies the atmospheric conditions (weather and climate).

Meteorology: Study of weather and climate.

Weather: The combination of temperatures, precipitation, cloud cover, and wind that are experienced on a daily basis.

Climate: A long term pattern of weather conditions. (Month to several years)

Satellites and radar technology are both used by scientists to monitor and observe weather phenomena (occurrences). Satellites are more widely used today because:

- they show a greater area of the earth's surface;
- can detect and monitor a storm (ie. Hurricane) over a considerable distance.
- more detail and accuracy about an incoming storm.

Statements of weather and climate . On lab and test.

Satellite image of a hurricane. Page 63

Absolute location: latitude and longitude position Relative location: south Atlantic and over Florida Eye of hurricane: dot in middle – spin in counter-clock direction Weather and other conditions associated with a hurricane:

- heavy rains
- extremely high winds
- high surf and excessive flooding

**Types of Rainfall** 

Convectional Rainfall:	Precipitation caused on hot summer days, when heated land causes the air above it to rise by convection. As the warm air rises it cools and condensation occurs. Rain or hail may fall from the thunderstorms that build up.
Convection:	Transmission of heat from one part of a liquid to another. When the lower portion of a mass of fluid is heated, it expands, its density is reduced (becoming lighter) and it rises, carrying its heat with it, to be replaced by cool fluid.
Condensation:	The process by which a substance changes from a vapour (gas) to the liquid state.
	(Heat into the clouds as it rises/cools and changes into rain/precipitation)

As the water condenses in the clouds, heat is released which can further intensify the storm. Thunderstorms on the prairies are often the result of this process.



#### **Frontal Precipitation**

Air masses that are different in temperature and moisture content do not mix. Rather a boundary or "front" is established.

A 'front' is the leading edge of an air mass . If the lead is warm then the mass is warm and conversely cold.

Frontal precipitation is also called cyclonic and it occurs along the area between two fronts. Air flow always occurs inward in a counter-clock direction (rotation).

Frontal Precipitation: Warm, moist air is forced to rise as it encounters a denser, colder air mass. The rising warm air reaches the condensation point. Clouds form and rainfall results.



Orographic/Relief Precipitation is another type. Warm moist air sweeps in over the ocean. It runs into mountains and is forced to rise over them. As it rises it cools and forms condensation and rain results. The cooler air passes over the mountain and down the other side creating extreme dry conditions. The rainy side of the mountain is called windward. The dry side of the mountain is called leeward.



In Newfoundland, for example, the most common form of precipitation is frontal/cyclonic. Warm and cold air masses meet. In the summer with the build up of heat on the land the island does experience convectional precipitation with thunderstorms and extremely heavy rainfall.

**Statements: True or False and explain.** 

Coastal communities tend to have high temperature ranges.

Locations with hot summers tend to have high average annual Temperatures.

Far North communities tend to have high levels of precipitation.

The higher you rise in a mountain the colder you get.

Scattergram: graph depicting the latitudinal position of places in accordance with their annual average temperature.

#### Typically the graph will show that the higher the latitude (towards the polar regions) the lower the temperatures

**Insert diagram:** 

How does the earth's shape affect the amount of solar radiation a given area receives?

One of the most important influences on climate is latitude. How far north or south of the equator a region is influences how warm or cold it will be.

The amount of heat energy, or radiation, that the earth receives depends on the angle of the sun's rays.

**Diagram:** 

Incoming solar radiation in A + B represents the same amount of potential radiation. However, in A, the sun's rays are at an angle greater than B. Thus they cover a larger surface area of the earth. As a result, temperatures in A are cooler than in B because the same amount of radiation must heat a greater surface area. This is why countries in the northern hemisphere have colder temperatures than places closer to the equator.

#### Wind

Air, like everything else on earth, has weight. Its weight is created by the force of gravity and is called air pressure.

The higher you are the lighter the air, thus less air pressure.

- Wind: Horizontal movement of air over the earth's surface. It is caused by differences in air pressure.
- Low pressure: heating of the ground by the sun warms the air above it and causes air to rise. This procedure produces a low pressure.
- High pressure: the air cools and sinks. This produces a high pressure.
- Air at ground level moves from high pressure to low pressure, creating wind.Rising air causes convection currents like an oven.

**Diagram:** 

# **Prevailing Winds**

Winds that are most commonly found in an area. In Canada, they are called westerlies because the predominate wind blows from the west.

Around the world, there is a system of high and low pressure belts. The movement of air between these belts of highs and lows has created a well-established patterns of winds which blow from west to east over most of Canada. These winds are called prevailing westerlies. The high pressure area alternate with the low pressure areas creating changing weather conditions.

#### Wind Direction

Even though there are prevailing winds, air flows from all direction creating local winds. Factors that determine local winds:

- season of the year
- sea/ land breezes
- ocean currents
- landforms
- jet stream
- shifting of the sun

# Wind Chill

A living organism exudes heat. When wind comes in contact with this organism it can reduce the heat thus making it colder than it actually is; creating chill.

As temperatures fall and the winds howl, we begin hearing about the danger of "wind chill". The wind chill index combines the temperature and wind speed to tell you how cold the wind makes it "feel".

Even though the chill is given as a temperature, it is not really a different kind of temperature. Low wind chill temperatures shouldn't keep you from going out but encourage you to dress properly.

#### Air masses

Air is constantly moving around the earth. Air flows from the equatorial regions to cold polar regions and back again. This large volume of air is called air masses.

Air mass: a large volume of air with uniform moisture and temperature content.

Canada is greatly affected by :

- 1. cold air masses in the winter from the arctic region;
- 2. hot/warm air masses in summer from the tropical regions.

Air flow from the land produces dry air and from the ocean produces moisture laden air.

## Air Mass classification: Moisture and Temperature

m: maritime = wet
c: continental = dry

T: tropical = hot P: polar = cold A: arctic = extreme cold

Assignment

**Identify the following:** 

mТ

mP

mA

сT

cP

cA

Use figure 4.8 and figure 4.10 on pages 52 and 53 of your text to describe the characteristics of each air mass. Use the chart, Figure 4.9 on page 52 to help organize your answer.

Origins of air masses: South in summer and North in winter. mT in the summer and cP in the winter.

Page 53 textbook

Air masses are influenced by the jet stream Page 54-55

Jet Stream: A west to east movement of air flowing at speeds of up to 400 km/hr at an altitude between 8,000 and 15,000 m.

Typically the jet stream moves north in the summer and south in the winter.

The westerly flow of the jet stream describes the dominant wind system for Canada.

Ocean currents affect wind conditions, temperatures, precipitation amounts, and cloud cover.

Ocean Currents: A movement of the surface water of the oceans. Affected by wind, salinity (salt), rotation of the earth, and temperatures.

Circulation of main ocean currents between equator and temperate (middle latitudes) region (30-60 degree latitude) is clockwise in northern hemisphere and counter-clockwise in the southern hemisphere. The east coast of Canada is affected by the Labrador Current and the Gulf of Mexico Current, thereby producing a cool, moist air effect.

West Coast of Canada is affected by the California Current, Gulf of Alaska, North pacific Current and Equatorial Current producing warm, moist air effect.

**Elevation:** The height above sea level (altitude). It affects both temperature and precipitation levels.

1 degree Celsius decrease in temperature for every 100 metres rise in altitude. (based on dry air)

0.6 degree Celsius decrease in temperature for every 100 metres rise in altitude for air that is laden with moisture/water vapour.

Why does an increase in elevation result in a decrease in temperature?

One would think that the higher you go up a mountain the warmer you will feel because you are closer to the sun. In fact the opposite occurs.

Temperature decreases as altitude increases. This is so because when the sun's rays pass through the atmosphere, they have little affect on air temperatures. The earth absorbs the heat energy. It then releases it into the air. So the further up the air is from the ground the cooler it is. Rainshadow: Once air passes over a mountain top/ land mass it becomes quite dry. Dry area or rainshadow is produced.

Windward: The side or direction which faces the wind.

Leeward: The side or direction which is sheltered from the wind.

Windward side of a mountain usually yields high levels of precipitation. Whereas on the leeward side of mountain experiences dry periods and sometimes even a Chinook. This is a warm, dry wind that can bring relief to cold winter days.

Conditions associated with orographic rainfall:

- Heavy Clouds
- Excessive Rainfall
- Warm breezes (mild temperatures)

Mountains force warm air from the ocean to rise. As it ascends it cools and the result is large amount of precipitation falls on the windward side of the mountain. It creates a dry and often warm condition on the east side of mountains.

Temperature Range; A calculation made by subtracting the coldest temperature from the warmest temperature.

Page 60-61

What is the temperature range for each of the following places:

- Brandon, MB -
  - St. John's, NL
- Halifax, NS
- Saskatoon, Sk
- Toronto, ON

Land = heats up quickly and cools down quickly

**Sea** = heats up slowly and cools down slowly

Why?

Water is translucent (clear) therefore, heat takes time to penetrate its depths and conversely, it takes a longer time to lose its heat.

Shallow water heats up and cools down more quickly than deep water.

Land breeze: occurs during the night. Air cools and blows off the land towards the ocean.



Sea breeze: occurs during the day. Air cools and blows off the water towards the land.



# Climograph

A combined line (temperatures) and bar (precipitation) graph showing the average monthly temperature and precipitation for specific areas.

Construct a climograph for any two (2) Canadian cities and label each by the city name. Page 60-61. See Lab #2

### **Continental Climate:**

- Usually found in the interior of large land masses.
- They are usually a long distance from large bodies of water.
- These areas experience hot summers and cold winters. The result is a large temperature range.
- There are times when these areas experience snow in the summer and high unseasonal temperature in the winter.

### **Maritime Climate:**

- Usually found along the coastal areas in nearness to the ocean.
- It experiences a cool summer and relatively warm/mild winter.
- There are times when a condition will occur when frigid, cold air will blow in from the arctic area in the winter and a hot air will blow in from the tropics in the summer.

Different areas of the world experiences anomalies: freak weather experiences.

To determine whether there is a continental or maritime climate one must:

- examine the temperature range
- examine the levels of precipitation
- examine the levels of temperatures

Factors that determine the climate in one local area for example:

- ocean currents
- wind direction
- air masses
- jet stream

How does wind affect the following?

- home-heating costs
- way you dress
- outdoor activities