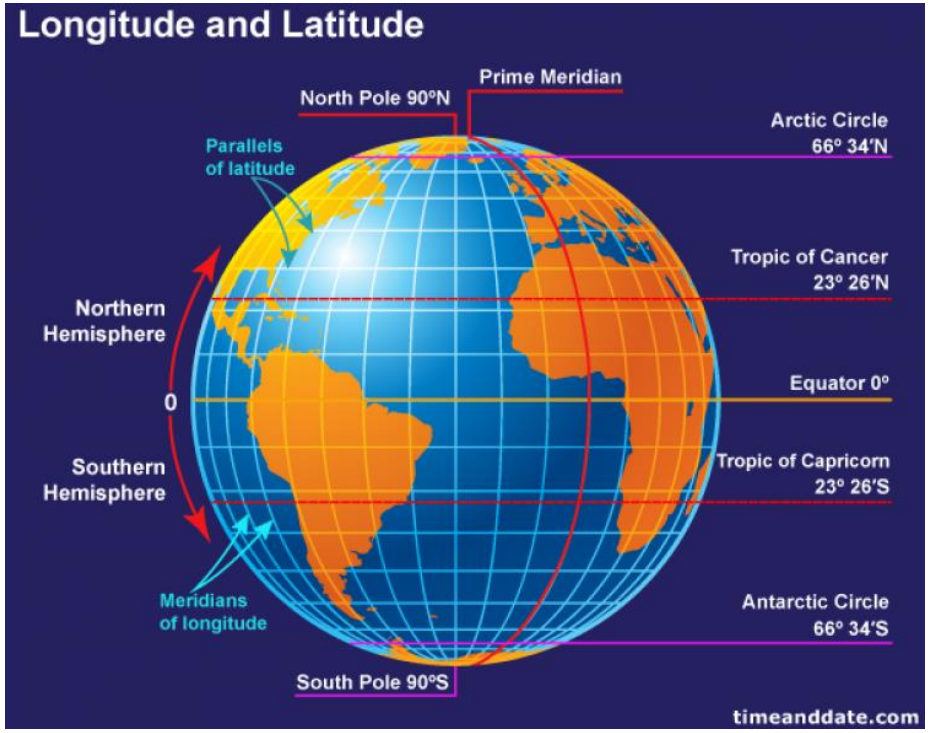
CANADA'S NATURAL SYSTEMS: CLIMATE SYSTEMS

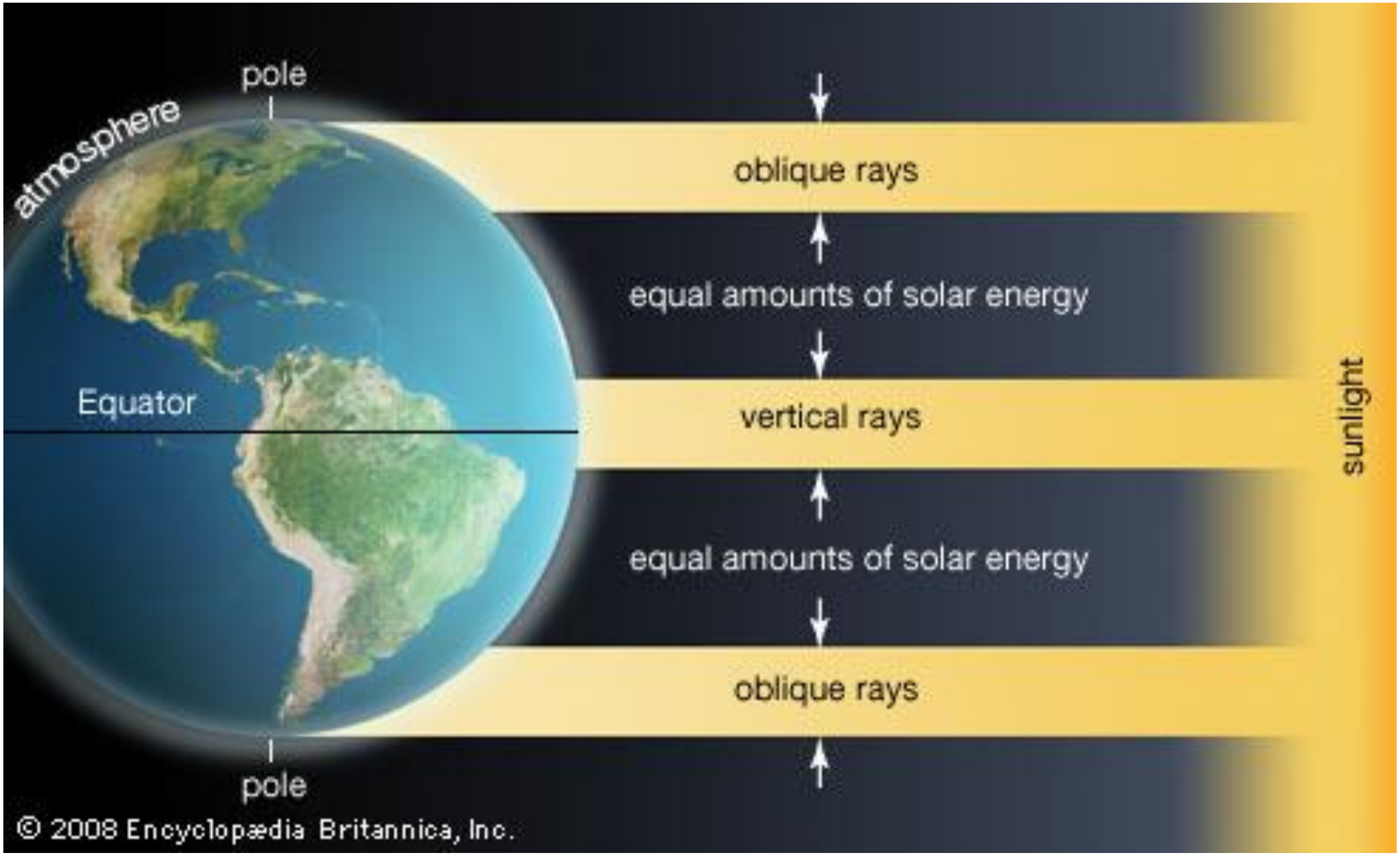
1. Latitude

- How far north or south of the Equator a region is influences how warm or cold it will be.
- *The further away from the Equator, the cooler it is.* This means it's coldest at the poles and warmest at the Equator.



Why latitude affects climate

- The amount of radiation (solar heat) the earth receives changes depending on the angle of the sun's rays.
- Near the Equator the sun's rays strike at a lower angle (direct rays), concentrating the sun's heat there.
- Near the poles the sun's rays strike at higher angles (oblique rays). This means a wider area is heated due to the curve in the earth's surface.


pole
atmosphere
oblique rays
equal amounts of solar energy
Equator
vertical rays
sunlight
equal amounts of solar energy
oblique rays
pole
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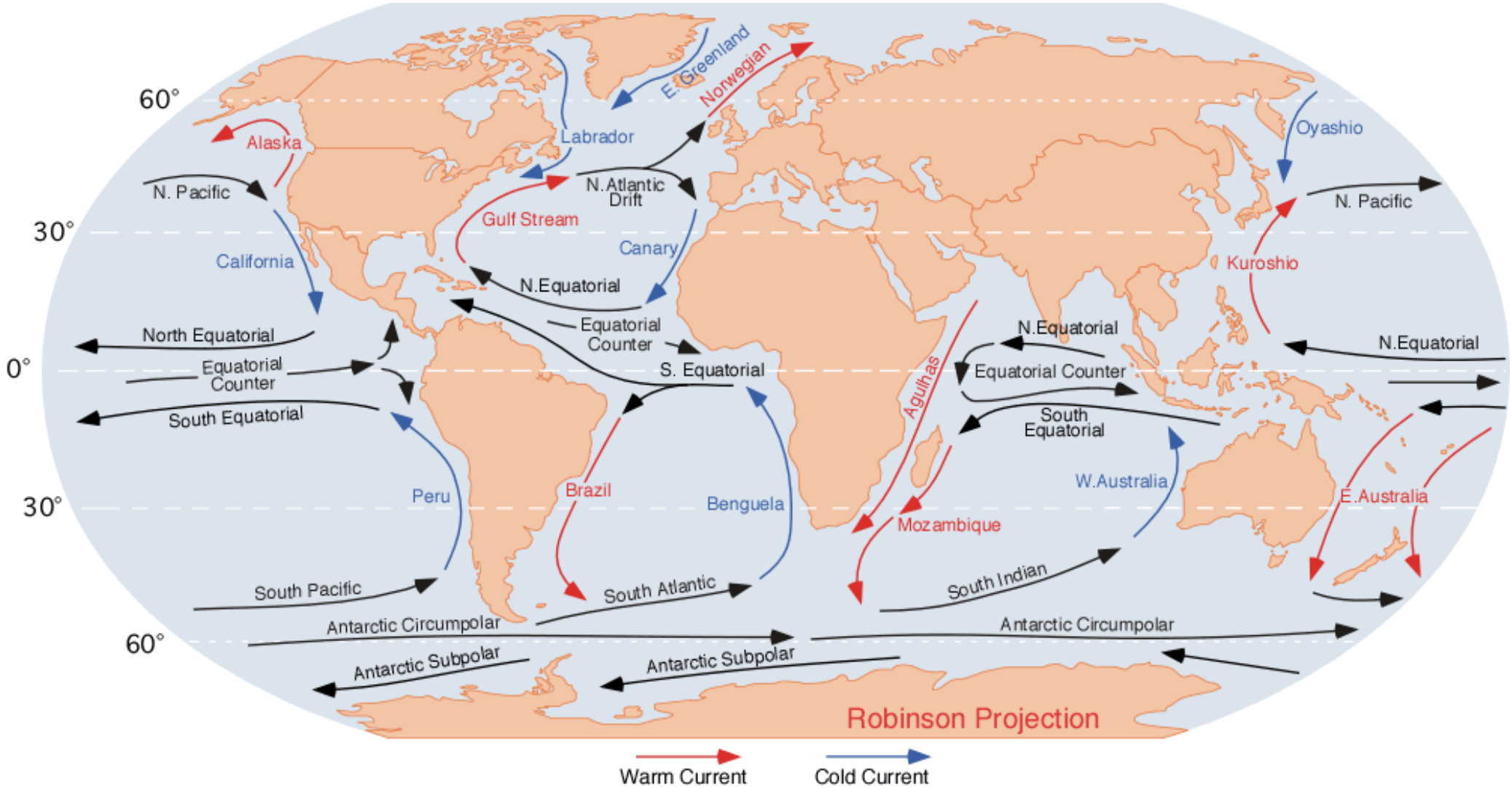
2. Ocean Currents

- Large streams of water that flow in the ocean; they flow in well defined circular patterns
- Can be strong and fast and usually flow in on direction
- Over half the heat that reaches the earth from the sun is absorbed by the ocean’s surface, so the surface currents move a lot of heat and have a great effect on climate

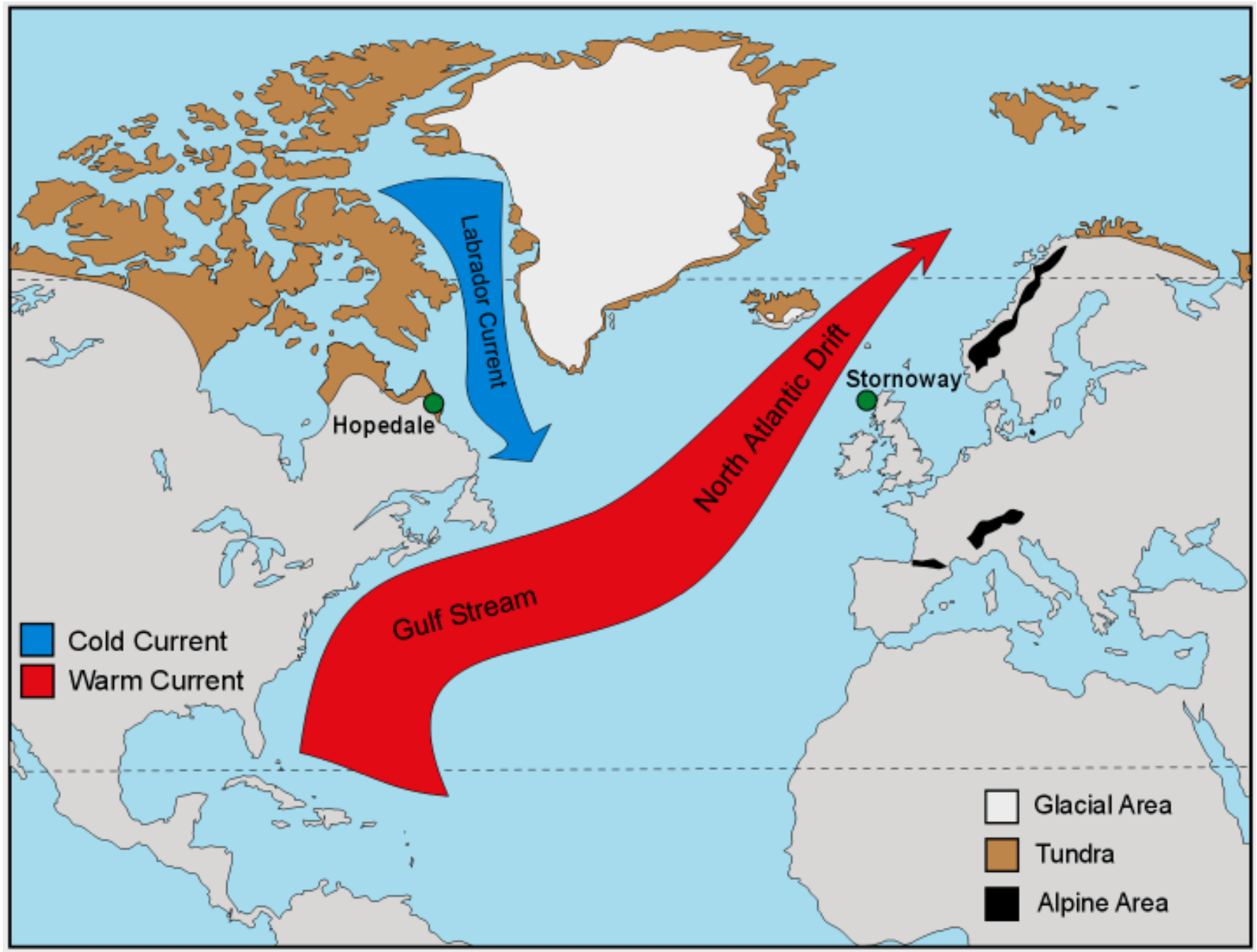

60°
30°
0°
30°
60°
Alaska
N. Pacific
California
Labrador
E. Greenland
Norwegian
N.Atlantic Drift
Gulf Stream
Canary
N.Equatorial
Equatorial Counter
S. Equatorial
North Equatorial
Equatorial Counter
South Equatorial
Peru
Brazil
Benguela
South Pacific
South Atlantic
Antarctic Circumpolar
Antarctic Subpolar
Oyashio
N. Pacific
Kuroshio
N.Equatorial
Equatorial Counter
South Equatorial
Agulhas
Mozambique
W.Australia
E.Australia
South Indian
Antarctic Circumpolar
Antarctic Subpolar
Robinson Projection
Warm Current
Cold Current

Two types of currents:

- Warm Currents: begin near the Equator and move warm water towards the poles
- Cold Currents: begin near the poles and move cold water towards the Equator
- *Areas near warm ocean currents have warmer temperatures than areas near cold ocean currents*

Examples of Ocean Currents That Affect Us

- **Gulf Stream**: a large ocean current originating in the Gulf of Mexico and flows north as far as the North Atlantic; helps make northern regions less chilly (i.e. Newfoundland)
- **Labrador Current**: Begins in the Arctic and flows south past Newfoundland and Nova Scotia; carries icebergs south in spring and summer; keeps region cooler in summer
- Warm air from warm currents colliding with cold air from cold currents produces **fog**.


Labrador Current
Hopedale
Stornoway
North Atlantic Drift
Gulf Stream
Cold Current
Warm Current
Glacial Area
Tundra
Alpine Area

3. Air Masses

- **Air masses** are huge volumes of air that move between the Equator and the Arctic
- Air masses can be warm or cold. If it originates in the warm tropic areas (near the Equator) it will be warm; if it forms in the cold Arctic, it will be cold.
- If air masses are formed over water they will carry a lot of moisture.

Air Mass Classification

- Air masses are classified based on their temperature and moisture levels (wet or dry).
- These are shown by a two-letter label
- Symbols:
- *Moisture content*

m = maritime (wet—formed over water)

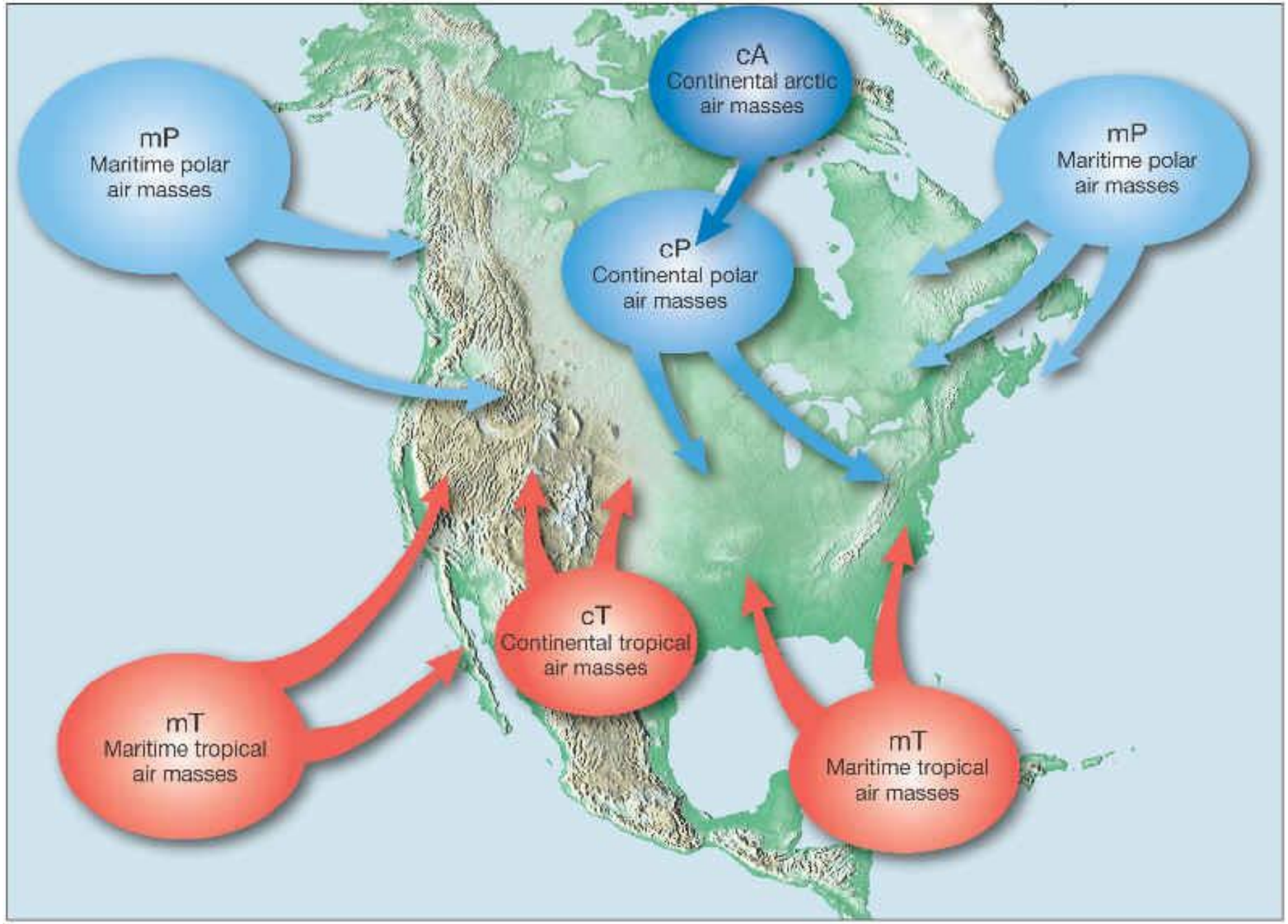
c = continental (dry—formed over land)

- *Temperature*

T = Tropical (hot—formed near tropics)

P = Polar (cold—formed between 55° and 66°N)

A = Arctic (very cold—formed over the Arctic)


cA
Continental arctic
air masses
mP
Maritime polar
air masses
mP
Maritime polar
air masses
cP
Continental polar
air masses
cT
Continental tropical
air masses
mT
Maritime tropical
air masses
mT
Maritime tropical
air masses

Air Pressure

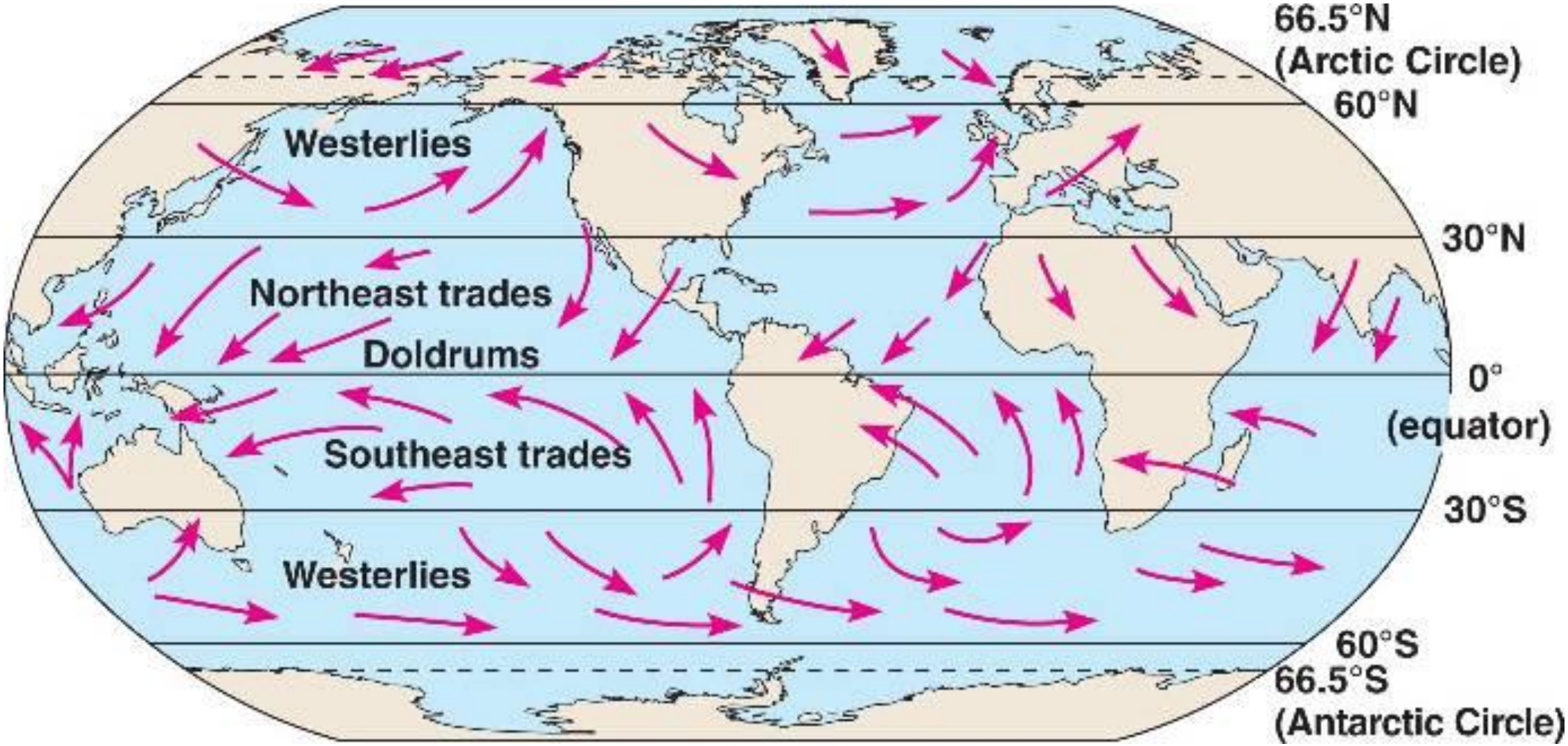
- The weight of air; weight created by force of gravity
- Cold, heavy air sinks (high pressure)
- Warm light air rises (low pressure)
- Less air pressure at high altitudes than at sea level
- Winds blow from areas of high pressure to low pressure (think of air inside a balloon being let out)

Winds

- Horizontal movement of air across the earth
- Vertical movements are called updrafts and downdrafts
- Created by differences in air pressure and temperature
- Winds blow from high to low pressure areas

Prevailing winds

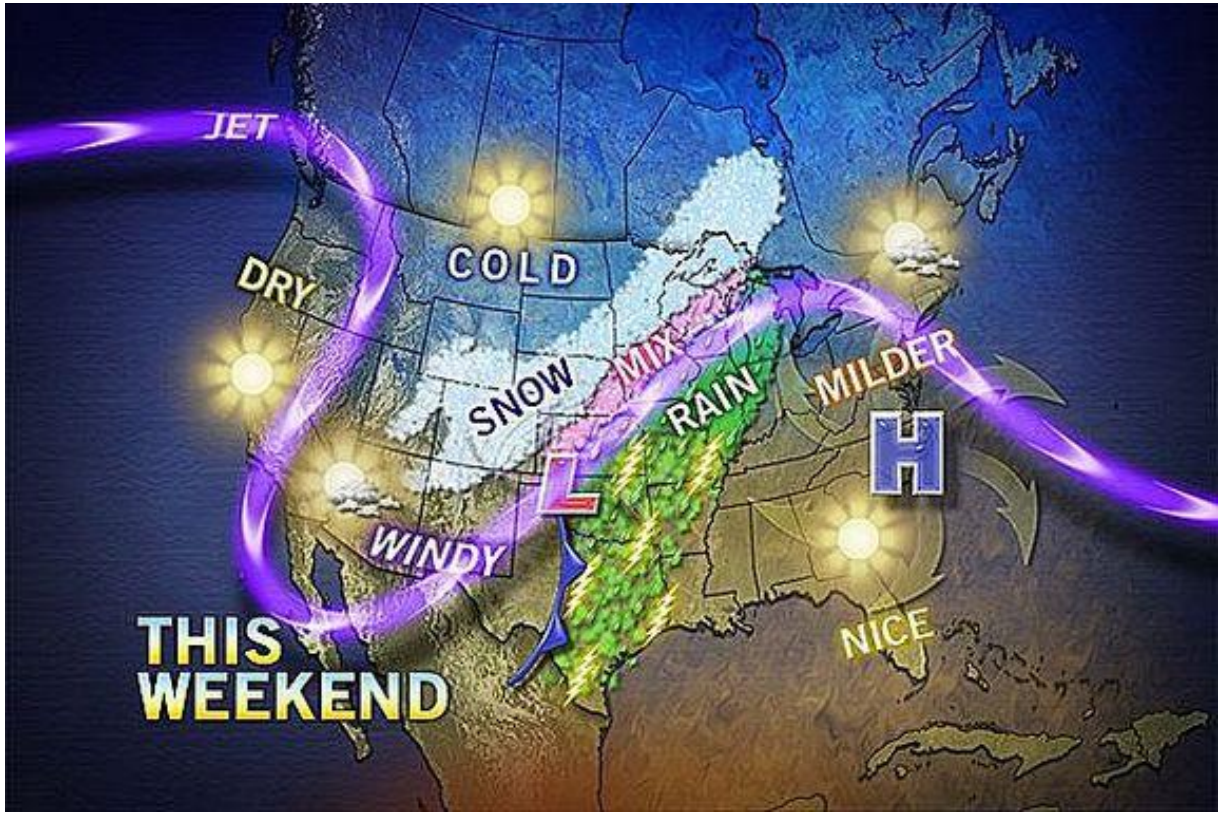
- Regular, predictable, normal wind direction for a give area or region
- Named after the direction from which it comes (westerly winds blow from the west to the east)
- Affects types of weather
- In Canada the main prevailing winds are the Westerlies


66.5°N
(Arctic Circle)
60°N
Westerlies
30°N
Northeast trades
Doldrums
0°
(equator)
Southeast trades
30°S
Westerlies
60°S
66.5°S
(Antarctic Circle)

The Polar Jet Stream

- Current of fast moving air (300-500km/h) found in upper levels of the atmosphere that moves from west to east across Canada
- Often moves farther north in summer and farther south in winter
- Has a strong influence on Canada’s climate where fronts meet
- Stronger in winter than in summer because of greater contrast in temperature (cold north air and warmer south air)


Polar Jet
Subtropical Jet


JET
DRY
COLD
SNOW
MIX
RAIN
MILDER
L
H
WINDY
NICE
THIS
WEEKEND

4. Altitude/Elevation

- **Elevation**: the height above sea level

Rising Air

- air temperature decreases as altitude increases (the further up into the air you go the colder it gets)
- sun's rays warm the earth and the heat from the earth rises into the air. The further from this heat source, the colder it gets

- *Dry and wet air cool down at different rates*:
- dry air decreases about 1°C for every 100m of altitude
- wet air decreases about 0.6°C for every 100m of altitude
- this difference occurs because as wet air cools **condensation** takes place (moisture in air changes from a vapour to a liquid = rain) and heat is released during this process

Falling Air

- as air falls it is warmed by the earth and increases in temperature
- the rate of heating is the opposite of rising air (temperature increases 1°C for every 100m of altitude)
- a **chinook** is a warm wind that occurs on the eastern side of the Rocky Mountains
  - as cold air descends along the mountain it can be heated very quickly (by up to 20°C!)
- by the time it reaches the Interior Plains it can deliver warm air on cold winter days

5. Nearness to Water

- large bodies of water influence climate
- water heats and cools at a slower rate than land
  - this is because sun's heat penetrates further down into water than it can into land, meaning there is more water to heat
- in summer the water will remain cooler than the land
- in winter the water will remain warmer than the land

- *Areas near the ocean will be affected by the water's temperature:*
- in summer the water is cooler than the land meaning coastal towns will have cooler temperatures than inland towns
- in winter the water is warmer than the land meaning coastal towns will have warmer temperatures than inland towns
- for this reason, areas near the ocean are said to have a **moderated temperature**

Maritime vs Continental Climates

- **temperature range** refers to the difference between highest and lowest average temperatures of a region
- **maritime** (coastal) climates have a low temperature range
- **continental** (inland) climates have a high temperature range
- inland areas are usually a long way from large bodies of water (not moderated), meaning they experience hot summers and cold winters

Sea Breezes and Land Breezes

- during the day water remains colder than land
- winds blow from cold areas to warm meaning a breeze will blow from the water over the land (a **sea breeze**)
- during the night water remains warmer than land
- winds blow from cold areas to warm meaning a breeze will blow from the land over the water (a **land breeze**)

Precipitation

- Most of the water vapour that condenses to form rain has evaporated from oceans and large lakes
- Places close to these bodies of water will therefore experience more precipitation

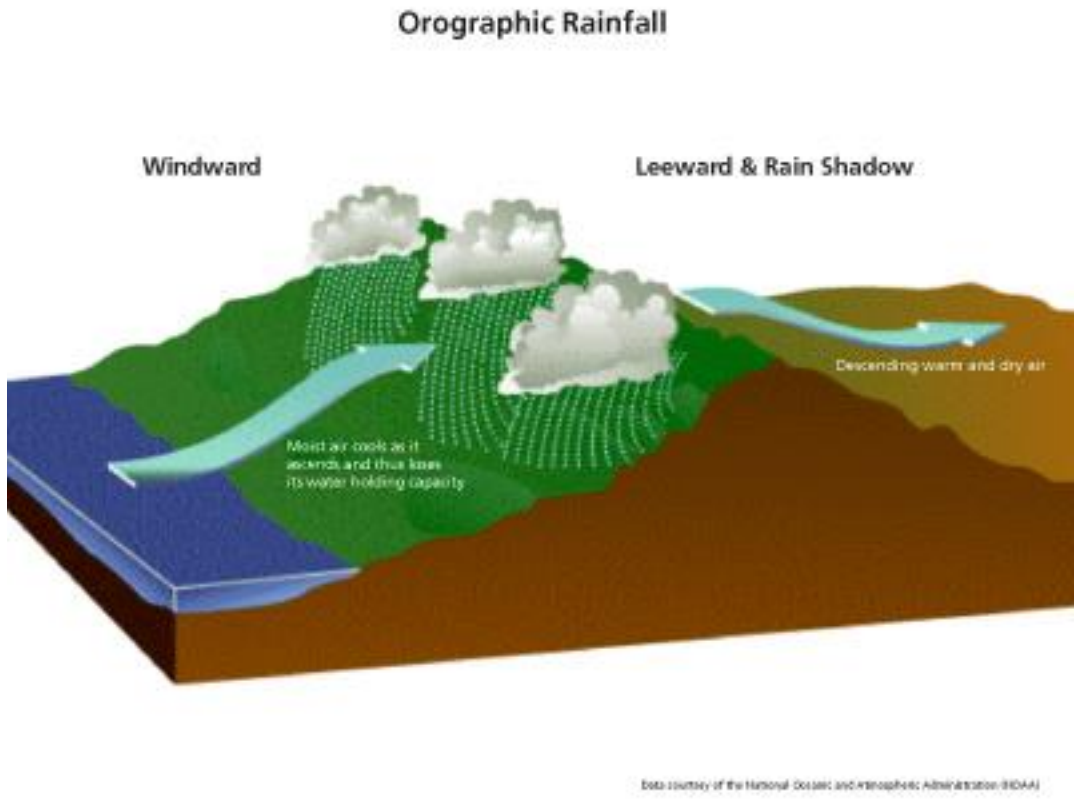
Types of Precipitation

- There are 3 types of precipitation:

1. Orographic
2. Frontal
3. Convectional

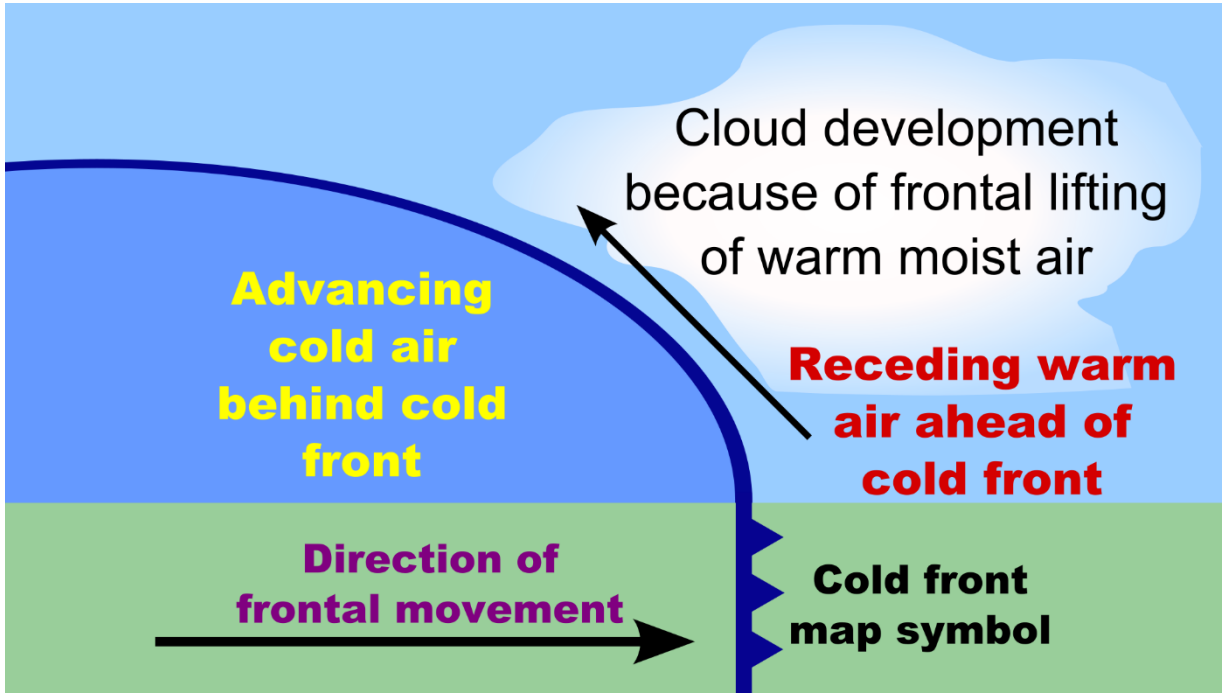
1. Orographic Precipitation

- Warm air from the ocean rises when it meets an obstacle such as a mountain.
- As the air mass rises, it cools off and the moisture condenses into rain clouds. The rain falls mainly on the **windward** side of the mountain.
- Meanwhile, the leeward side of the mountain gets very little rain (called a **rain shadow**). So in these situations one side of the mountain has much more vegetation than the other.



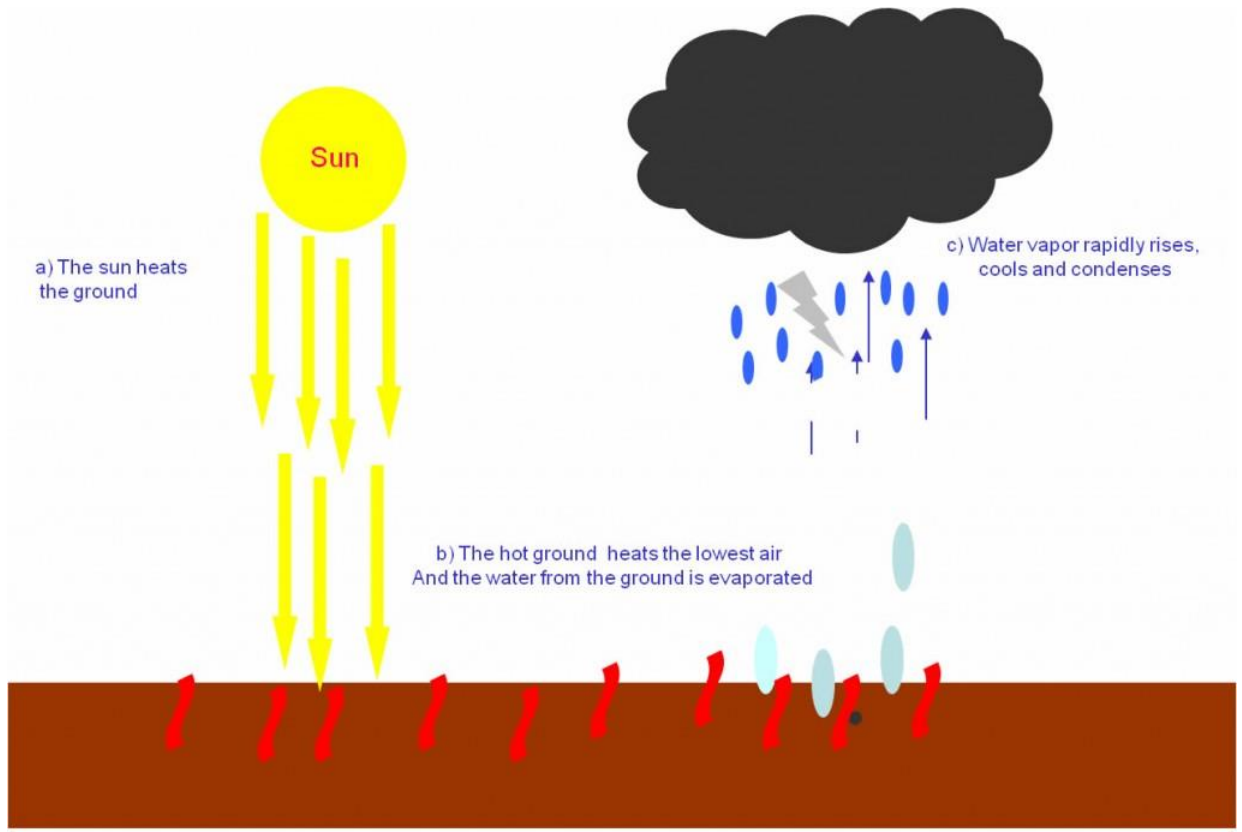
2. Frontal Precipitation

- This type is similar to orographic, except instead of a piece of land acting as an obstacle, the warm air mass has to rise up over a cold, more dense, air mass. The point where these air masses meet is called a **front**.



3. Convectional Precipitation

- With this type of rainfall, the sun heats up the land, which heats up the air at the surface.
- This warm air rises quickly. Then it condenses and falls back down as rain.



Types of rain
Convectional rain

Climate Graphs

- A **climate graph** is a diagram that is created using *average temperature and precipitation* information for a specific place.
- The information is usually collected for a year and displayed by month.
- A typical climate graph shows precipitation as a series of bars that start at the bottom of the graph and move up.
- The monthly average temperature is plotted as a set of dots that are joined to form a line across the graph.

Climate Graph Example: Vancouver, B.C.