



ENVE203

Environmental Engineering Ecology
(Oct 15, 2012)

Environmental Engineering Department

Elif Soyer

‘Ecosystem and Physical Environment’

Atmosphere, Ocean, Weather & Climate, Internal Planetary Processes



Atmospheric Circulation

Different locations of Earth



Different amount of solar energy



Differences in temperature



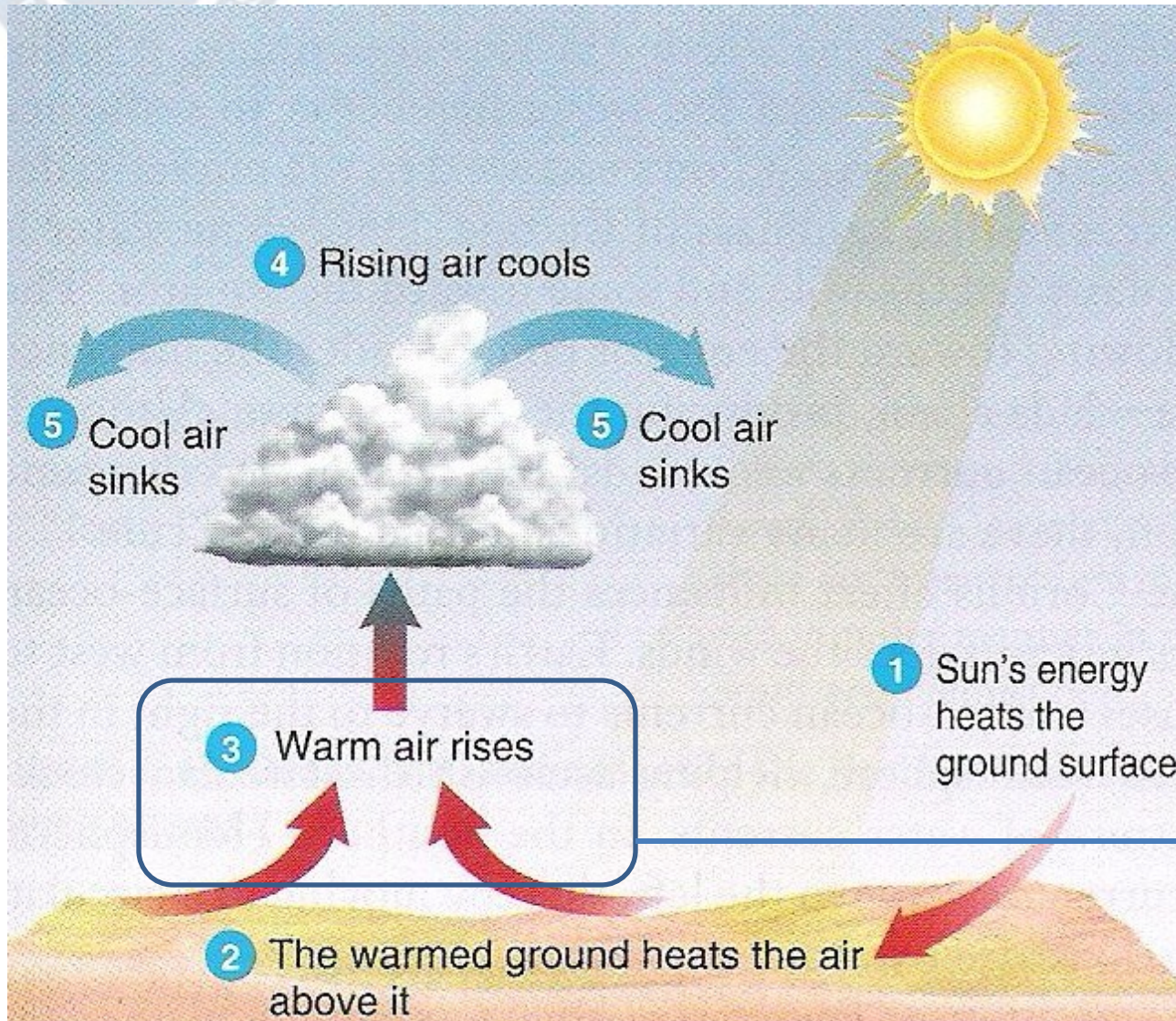
ATMOSPHERIC CIRCULATION

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Atmospheric Convection



Convection process causes air currents

Air currents mix warmer and cooler parts of the atmosphere

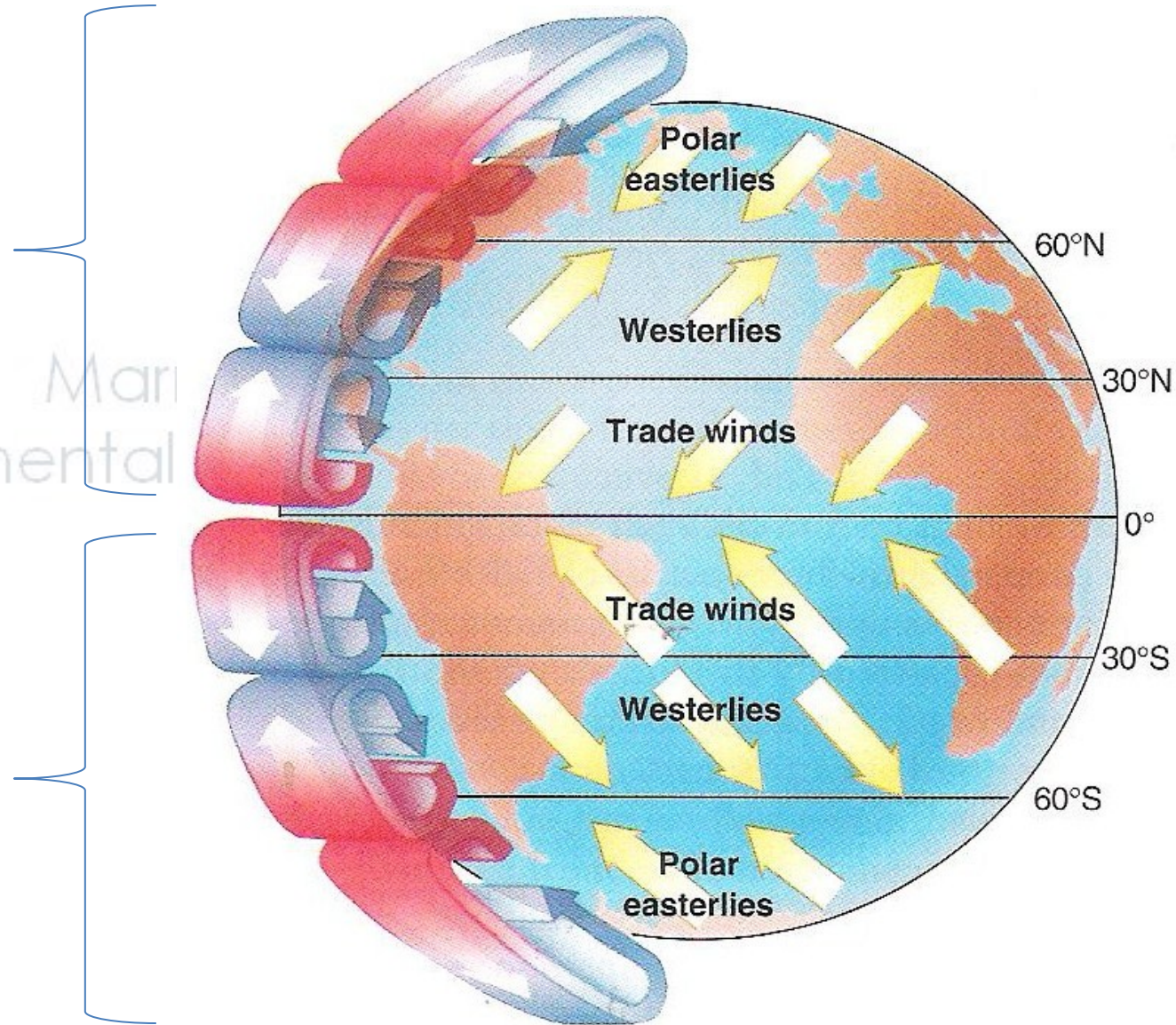
partment

Less dense, warm air rises 'convection'

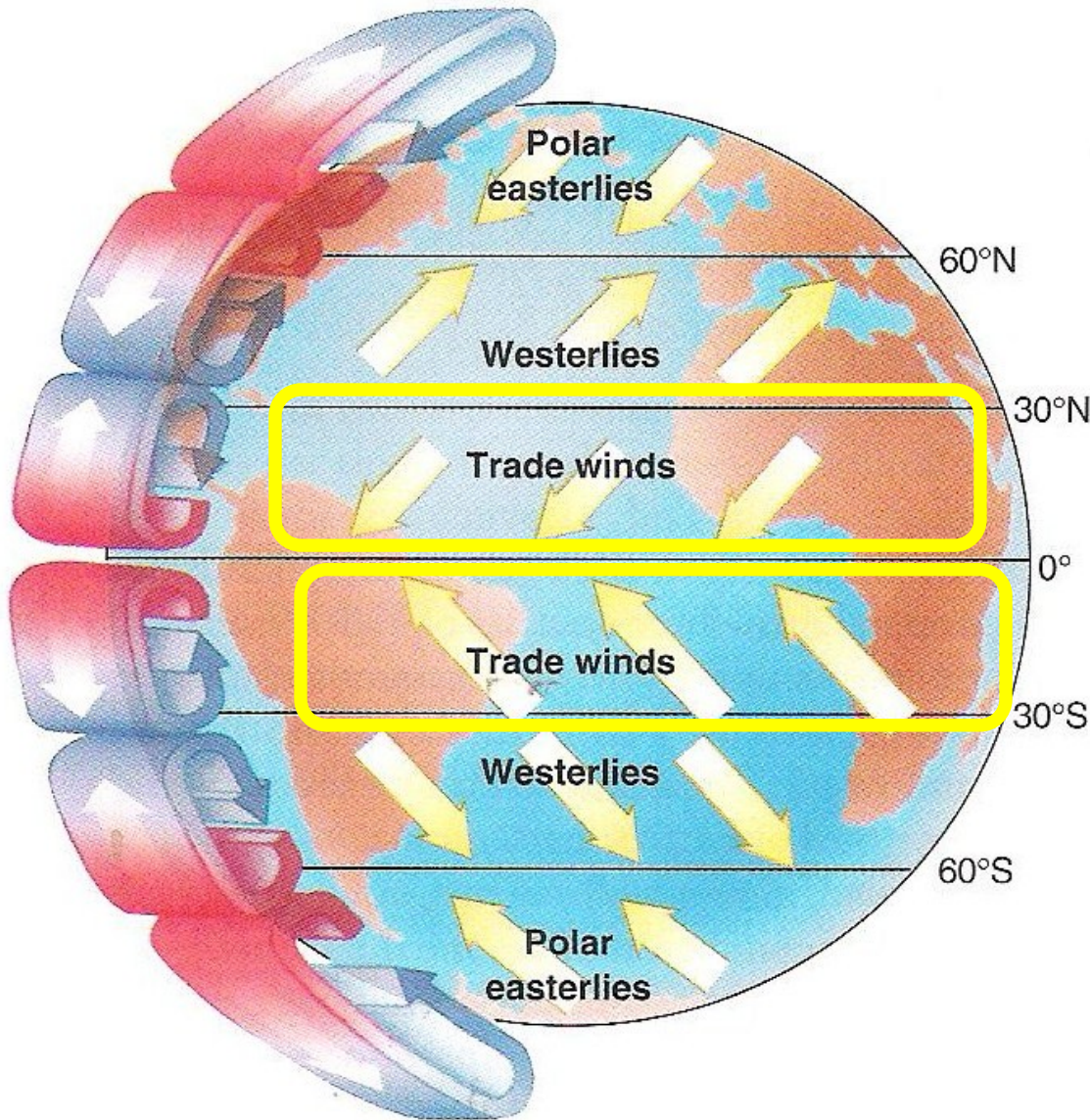


Atmospheric Circulation

Transport of heat
from equator to
the poles



Atmospheric Circulation



Heated air rises at the equator

Travels towards the poles and cools, much of it descends again at around 30° latitude in both hemispheres



Surface Winds



Complex horizontal movements: Winds

Results in

- Differences in atmospheric pressure
- Earth's rotation

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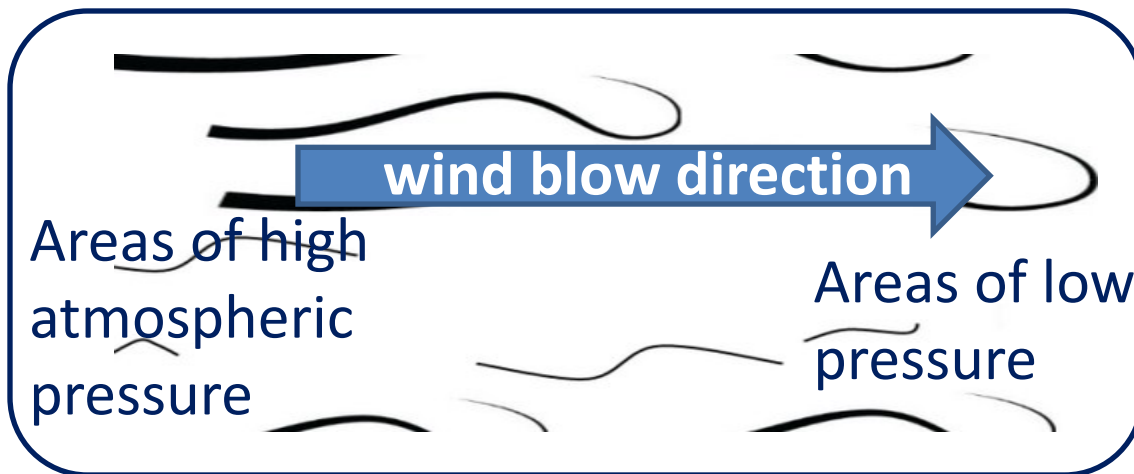
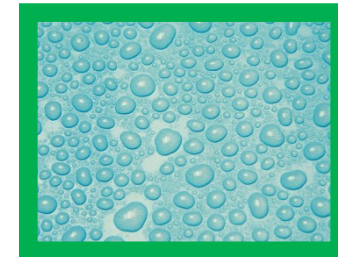
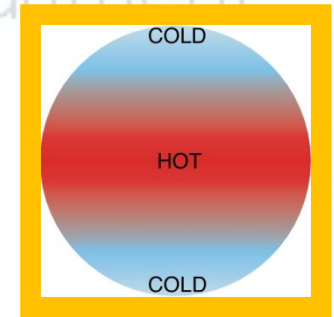
Surface Winds

Air pressure

Atmospheric gases have weight and exerts a pressure 1013 milibars (at sea level)

Air pressure is variable

Elevation
Temperature
Humidity



Areas of high atmospheric pressure

Areas of low pressure



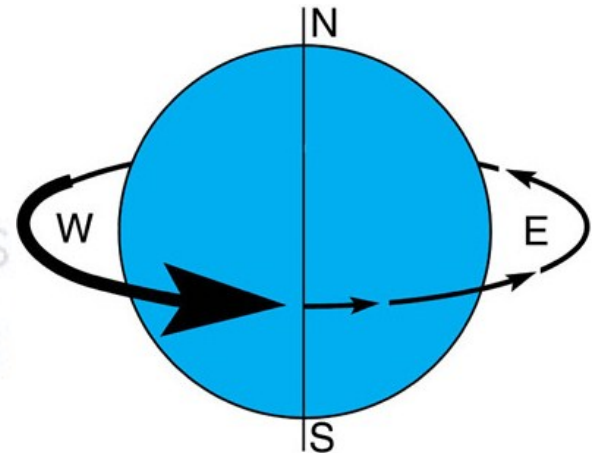
Direction of Wind

Earth's rotation influences the direction of wind

Rotates from west to east



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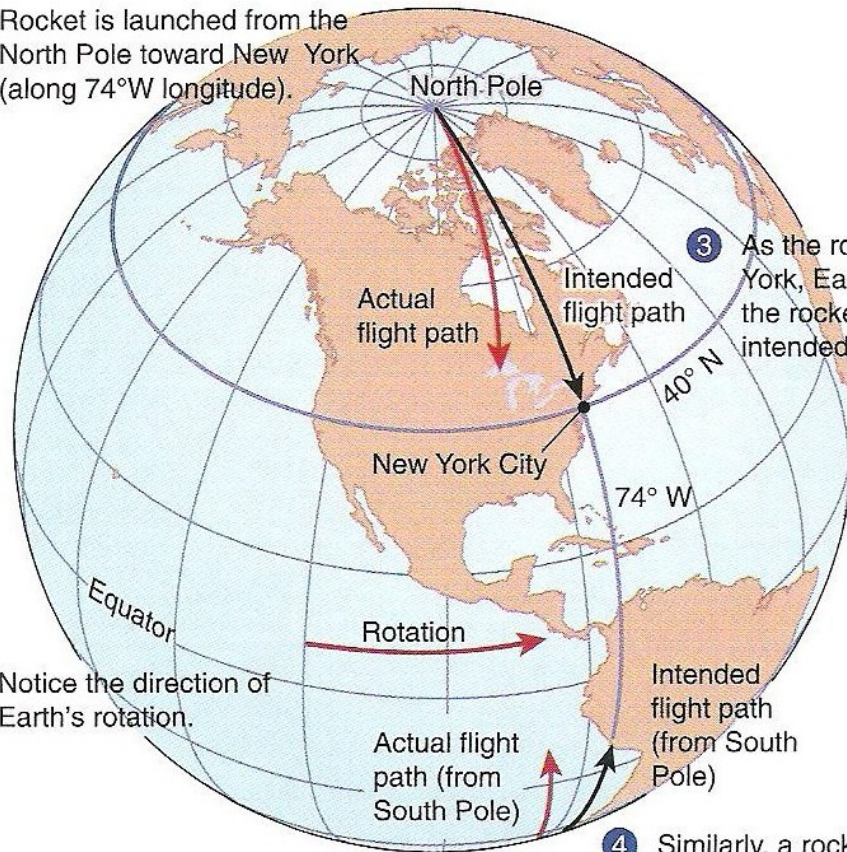
East-west movements of surface winds deflect from their straight-line paths

CORIOLIS EFFECT



Direction of Wind

- 1 Rocket is launched from the North Pole toward New York (along 74°W longitude).



- 2 Notice the direction of Earth's rotation.

- 3 As the rocket travels to New York, Earth's rotation causes the rocket to head west of its intended flight path.

- 4 Similarly, a rocket launched from the South Pole toward New York would head west of its intended flight path.

Coriolis effect

The influence of Earth's rotation, which tends to turn fluids (air & water) toward the right in the Northern Hemisphere and toward the left in the Southern Hemisphere

Direction of Wind



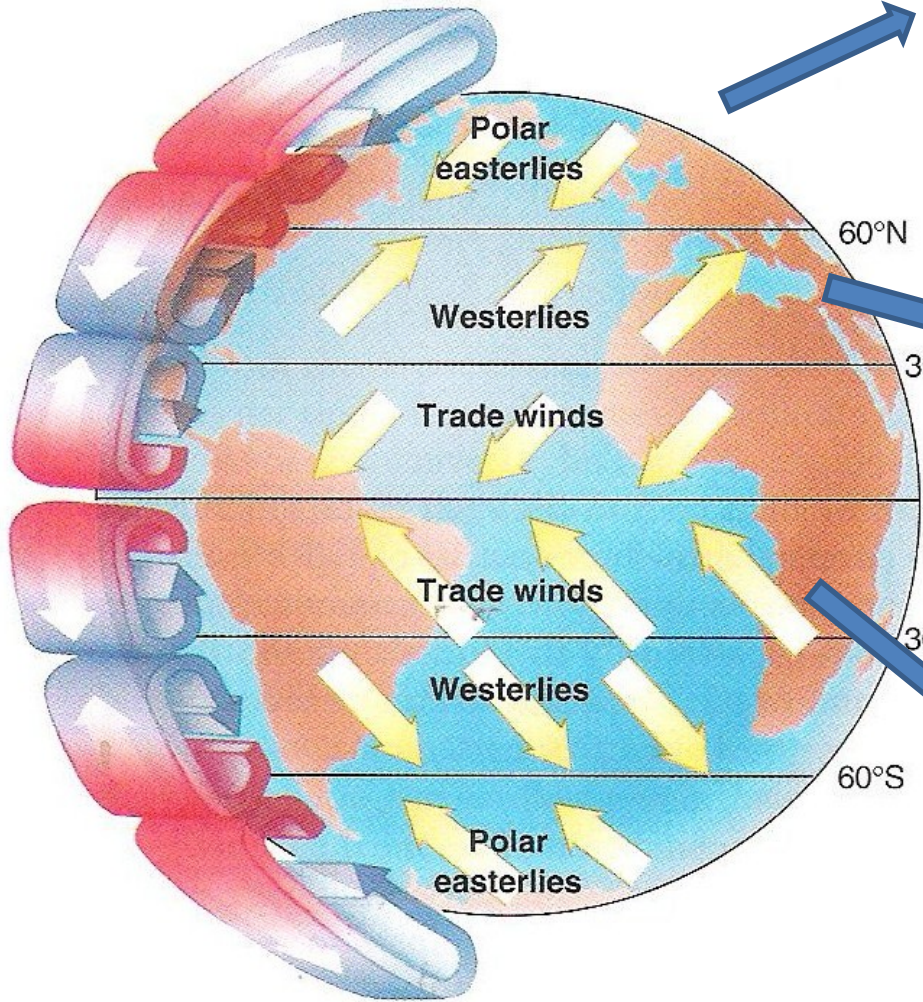
Coriolis effect

Greater at higher latitudes

Negligible at the equator

Air moving eastward or westward is not deflected from its path

The Atmosphere has 3 prevailing winds



Blow from northeast **near the North Pole**
or from the southeast **near the South Pole**

Winds that generally blow in the **midlatitudes** from southwest in the Northern Hemisphere or from the northwest in the Southern Hemisphere

Tropical winds



The Global Ocean

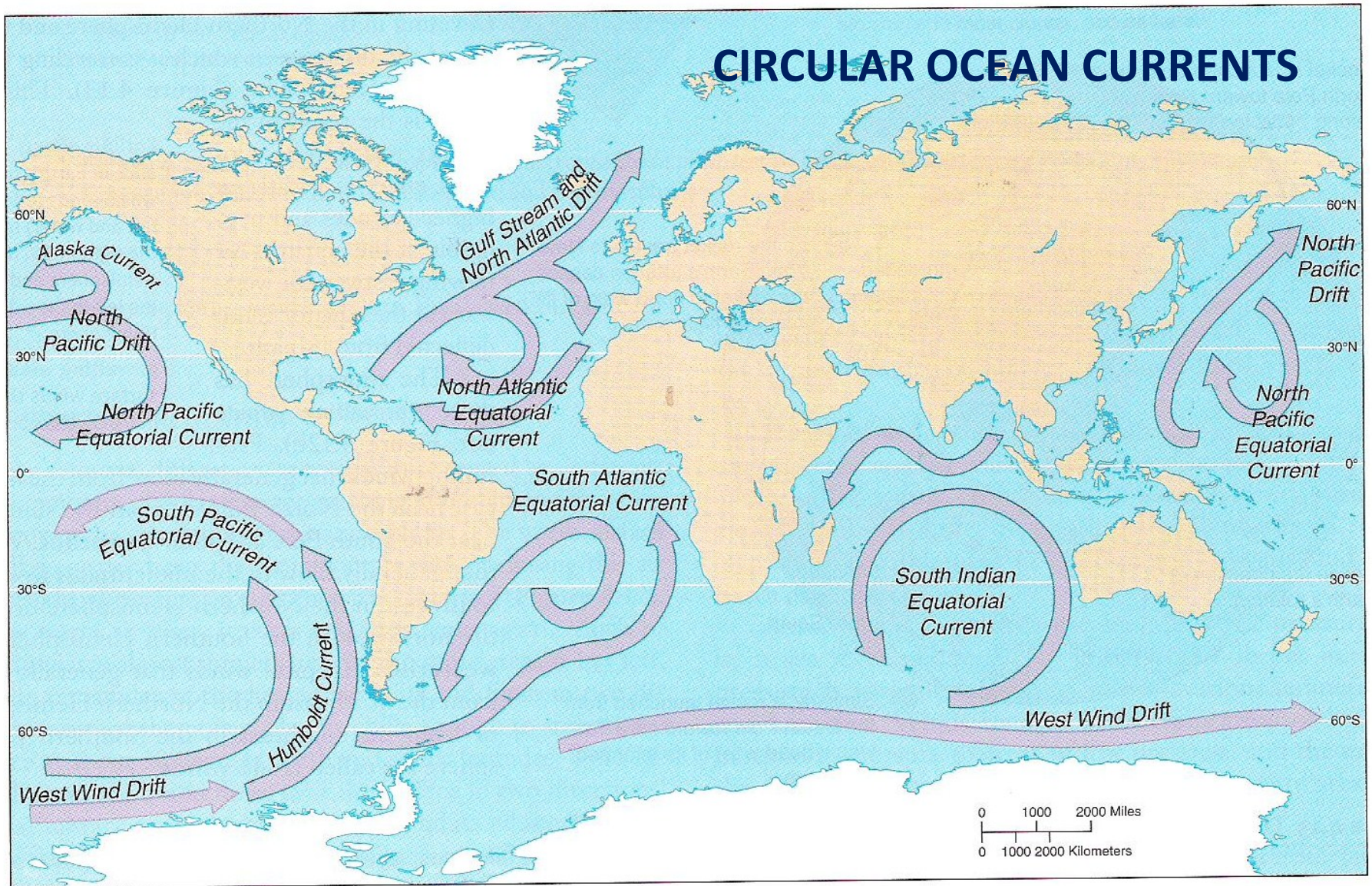
- Huge body of salt water that surrounds the continents and covers almost three-fourths of the Earth's surface
- A single, continuous body of water

Geographers divide into four sections separated by the continents:

- Pacific
- Atlantic
- Indian
- Arctic



- Largest
- Covers 1/3 of Earth's surface
- Contains more than half of Earth's water



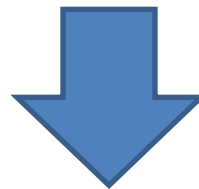
Prevailing winds over the ocean produce surface-ocean water currents
 Coriolis effect influences the paths of surface-ocean currents (as it does the winds)
A CIRCULAR, CLOCKWISE PATTERN OF WATER CURRENTS

OCEAN & LANDMASSES IN THE NORTHERN & SOUTHERN HEMISPHERE

The Northern Hemisphere
(as viewed from the North Pole)



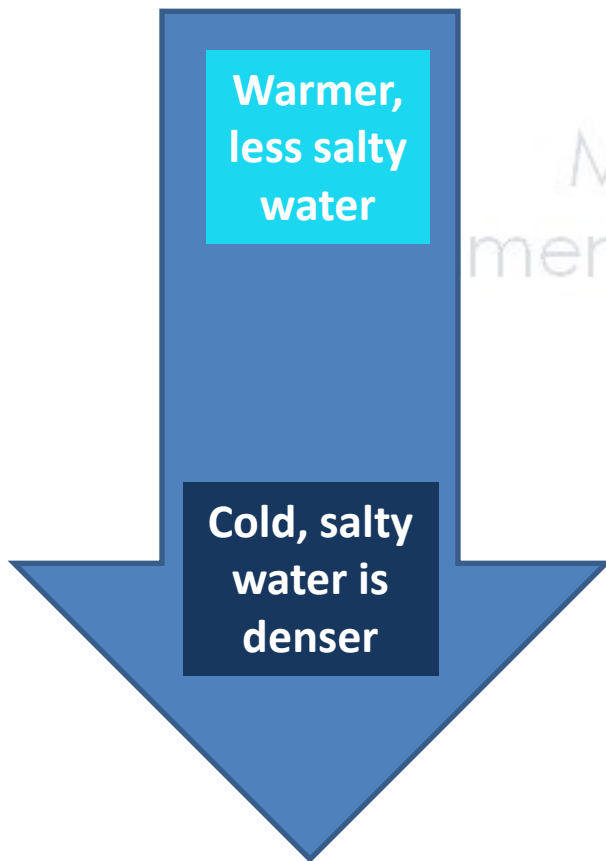
The Southern Hemisphere
(as viewed from the South Pole)



Ocean currents are freer to flow in a circumpolar manner in the Southern Hemisphere

Vertical Mixing of Ocean Water

The varying density (mass per unit volume) of seawater affects deep-ocean currents



Density of water increases with decreasing temperature down to 4 °C

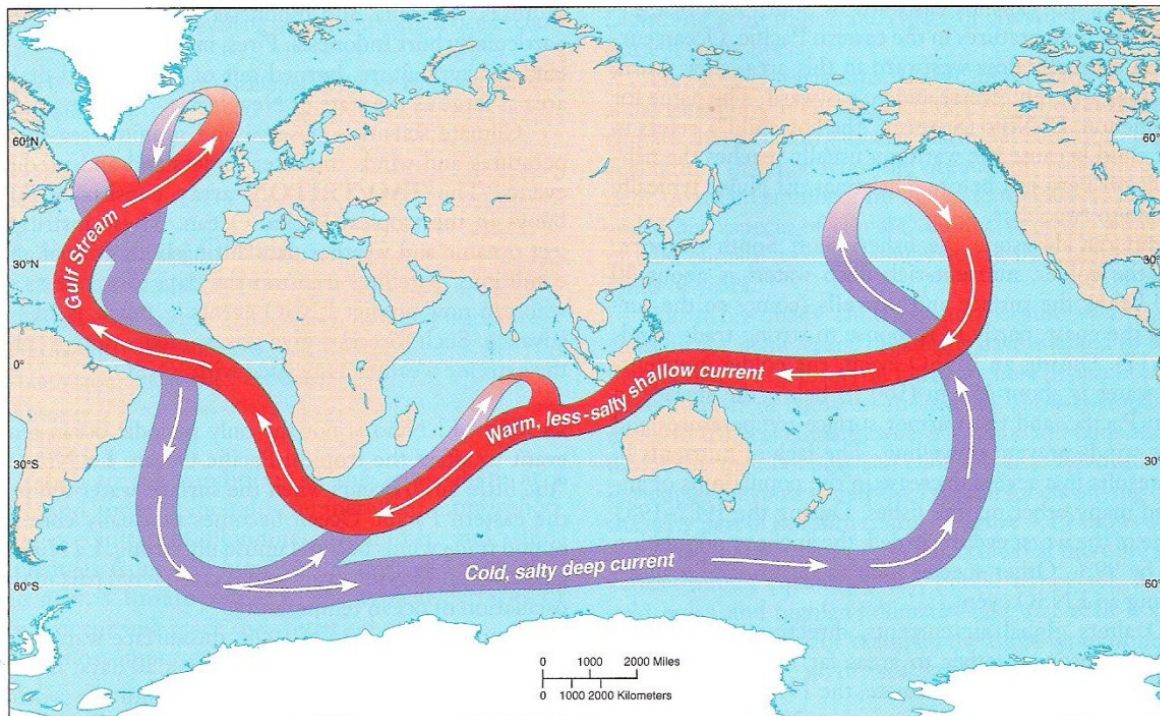
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Vertical Mixing of Ocean Water

Colder, salty ocean water sinks and flows under warmer, less salty water

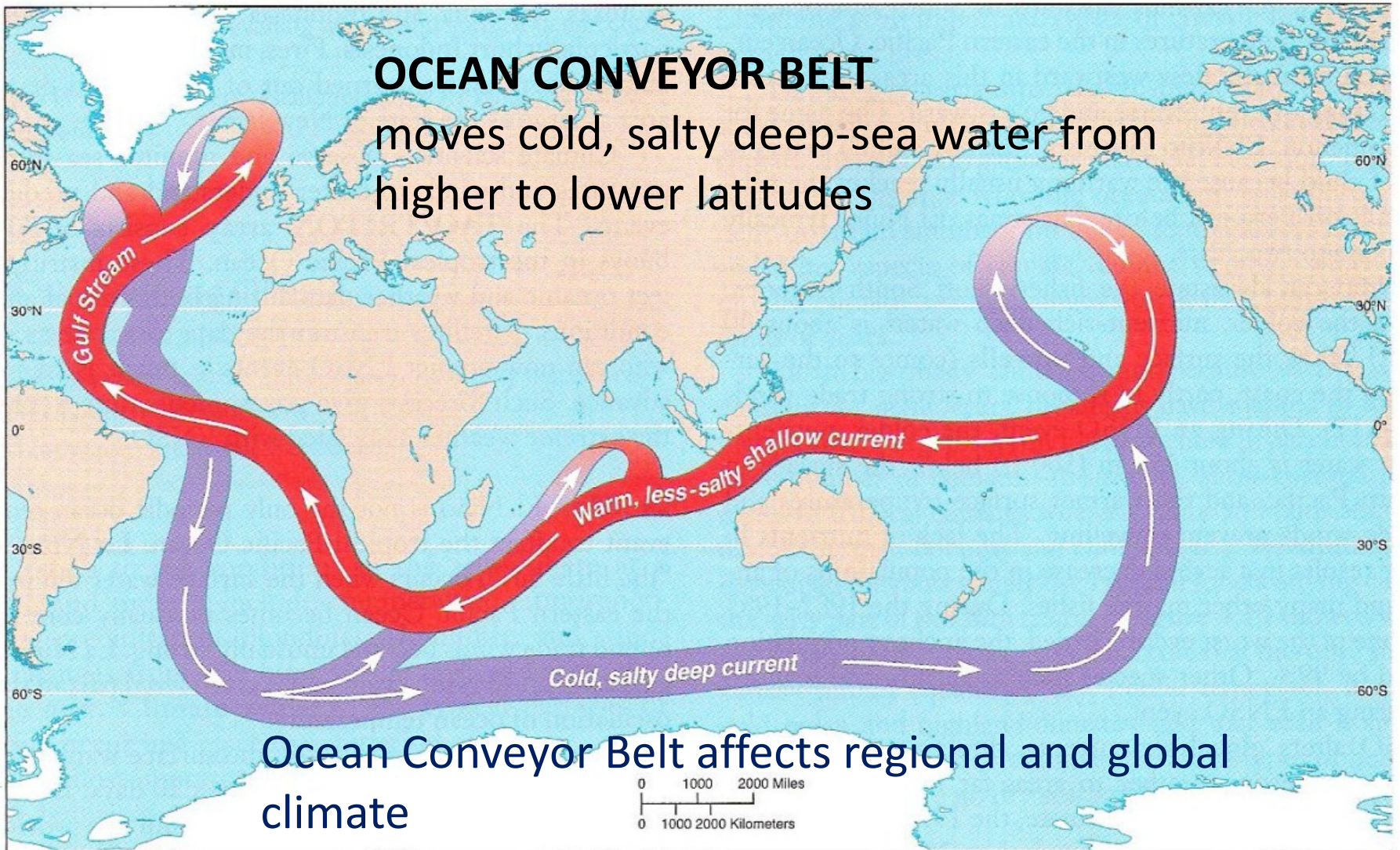


Currents far below the surface are generated



OCEAN CONVEYOR BELT

moves cold, salty deep-sea water from higher to lower latitudes

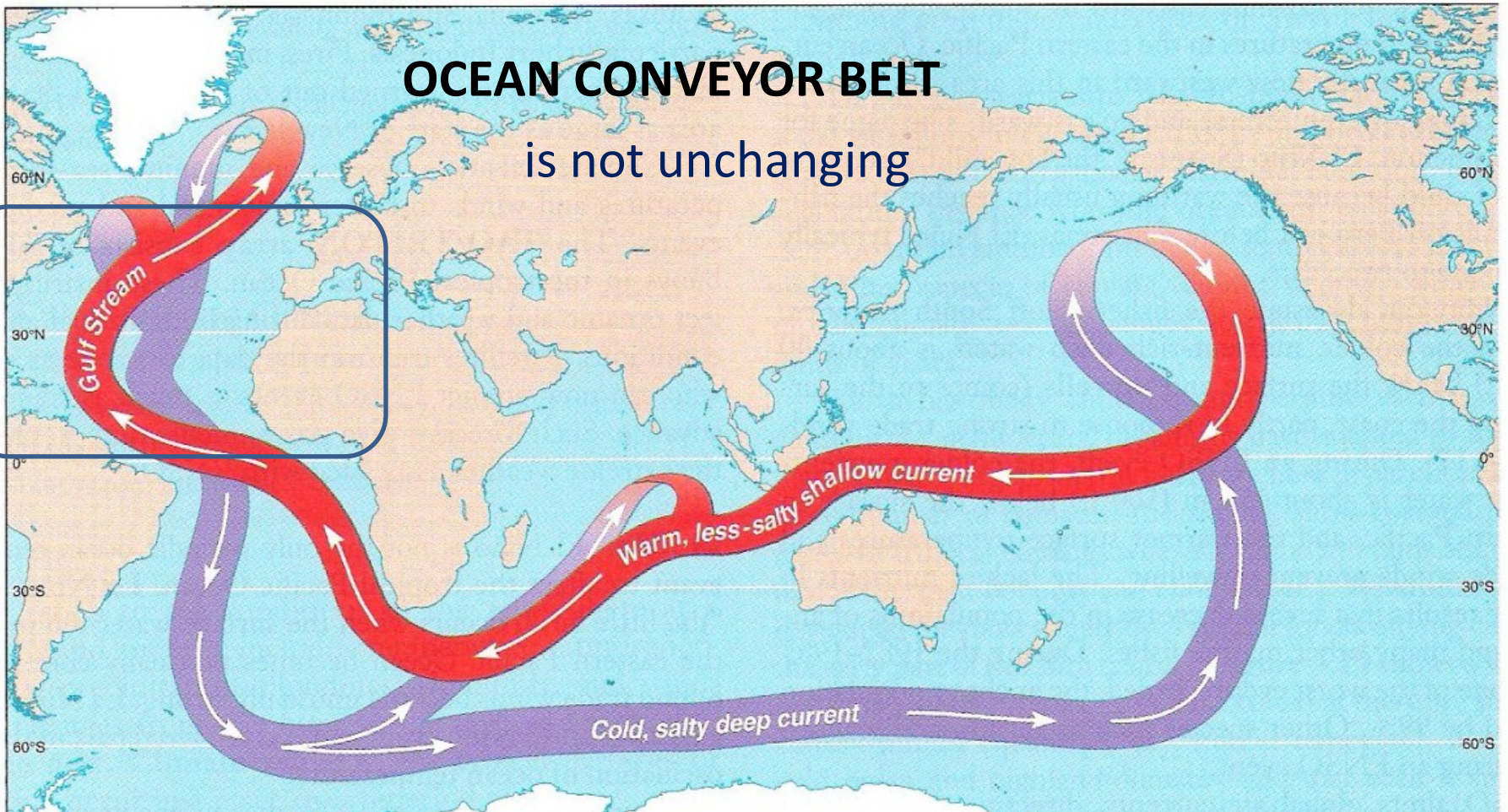


Ocean Conveyor Belt affects regional and global climate

It is responsible for the relatively warm climate in Europe
It is not unchanging

OCEAN CONVEYOR BELT

is not unchanging



Present ocean conveyor belt reorganized between 11,000 & 12,000 years ago.

During this period, heat transfer to the North Atlantic stopped, and both North America and Europe experienced conditions of intense cold. Global temperatures also dropped during this time



The Global Ocean

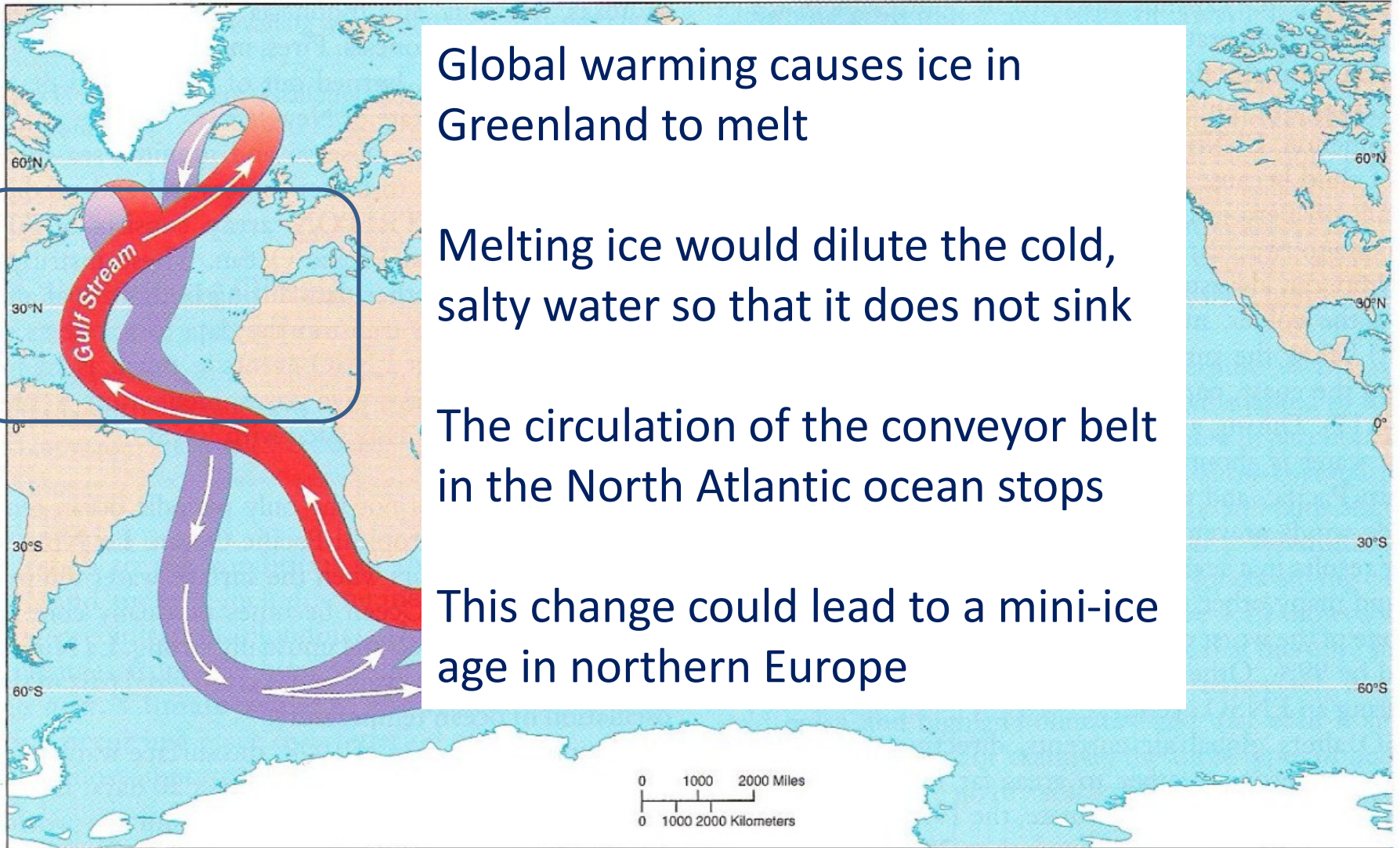
- Exact causes and effects of large shifts in climate are not currently known
- Scientists' concern: human activities may unintentionally affect the link between the ocean conveyor belt and the global climate

Global warming causes ice in Greenland to melt

Melting ice would dilute the cold, salty water so that it does not sink

The circulation of the conveyor belt in the North Atlantic ocean stops

This change could lead to a mini-ice age in northern Europe





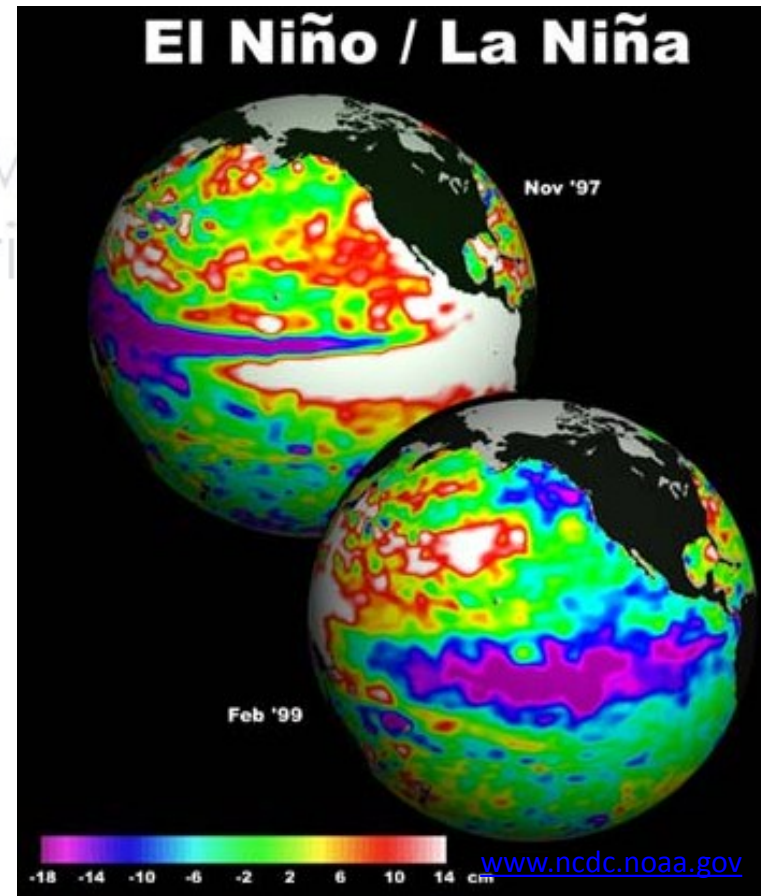
Ocean Interactions with the Atmosphere

The ocean and the atmosphere are strongly linked with

- Wind from the atmosphere affecting the ocean currents &
- Heat from the ocean affecting atmospheric circulation

El Nino-Southern Oscillation (ENSO, or simply El Nino)

one of the best examples of the interaction between ocean and atmosphere



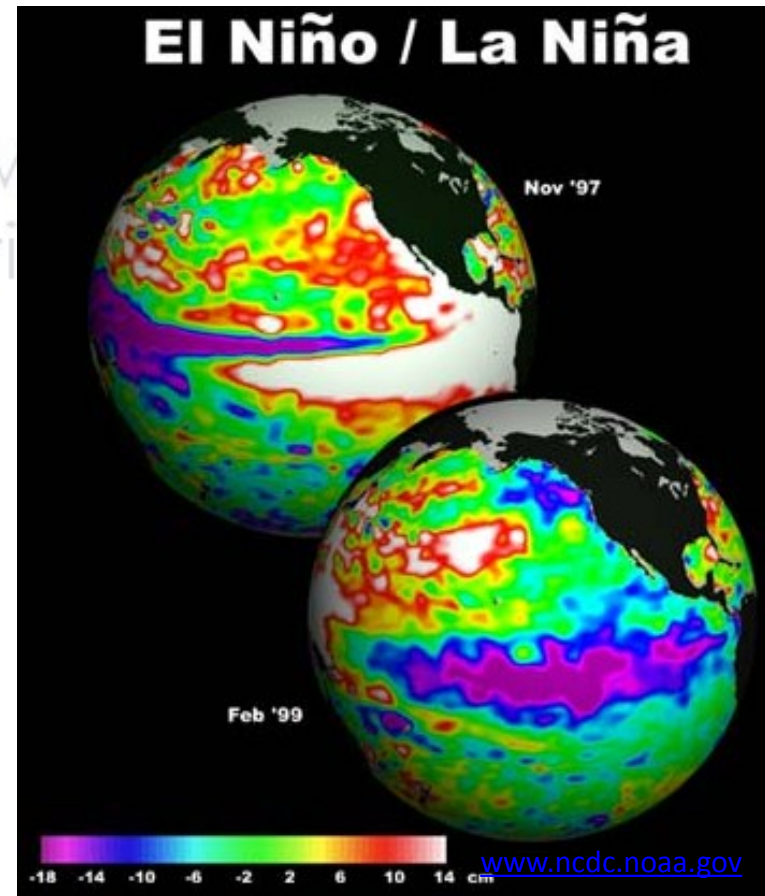


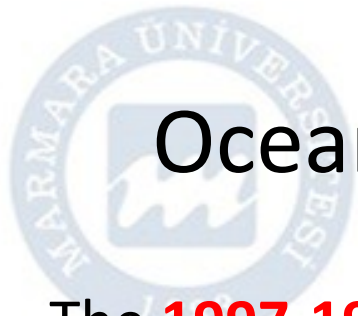
Ocean Interactions with the Atmosphere

**El Niño-Southern Oscillation (ENSO,
or simply El Niño)**

in Spanish 'the boy child'

is responsible for much of Earth's
interannual (from one year to the
next) climate variability



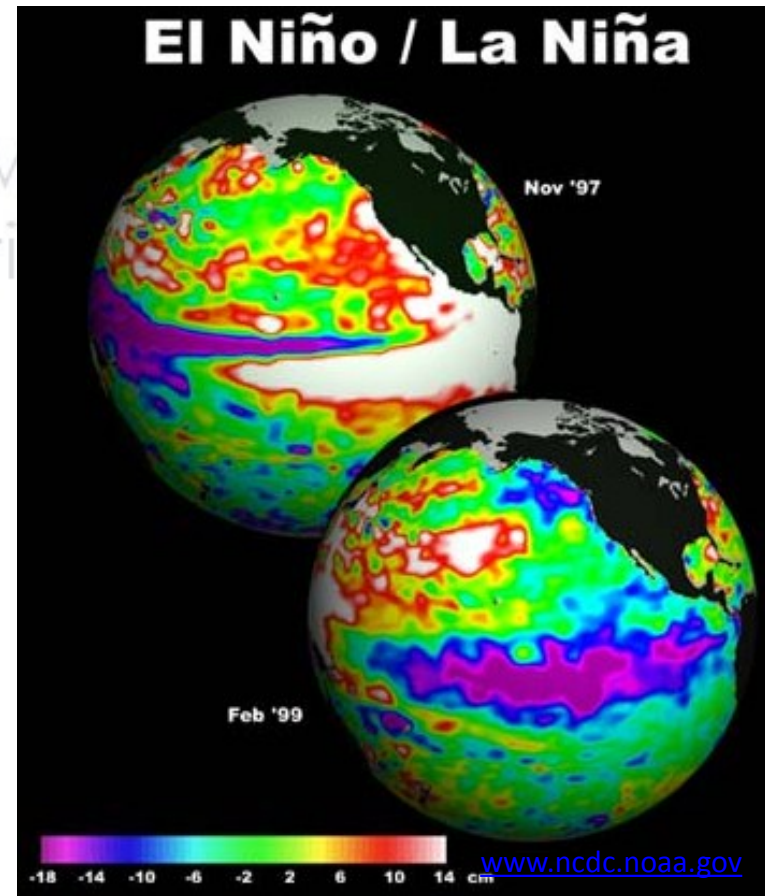


Ocean Interactions with the Atmosphere

The **1997-1998 El Niño**

Caused more than 20,000 deaths and \$33 billion in property damages worldwide

- Heavy snows in western United States
- Ice storms in eastern Canada
- Rains that flooded Peru, Ecuador, California, Arizona, and Western Europe
- Droughts in Texas, Australia, and Indonesia





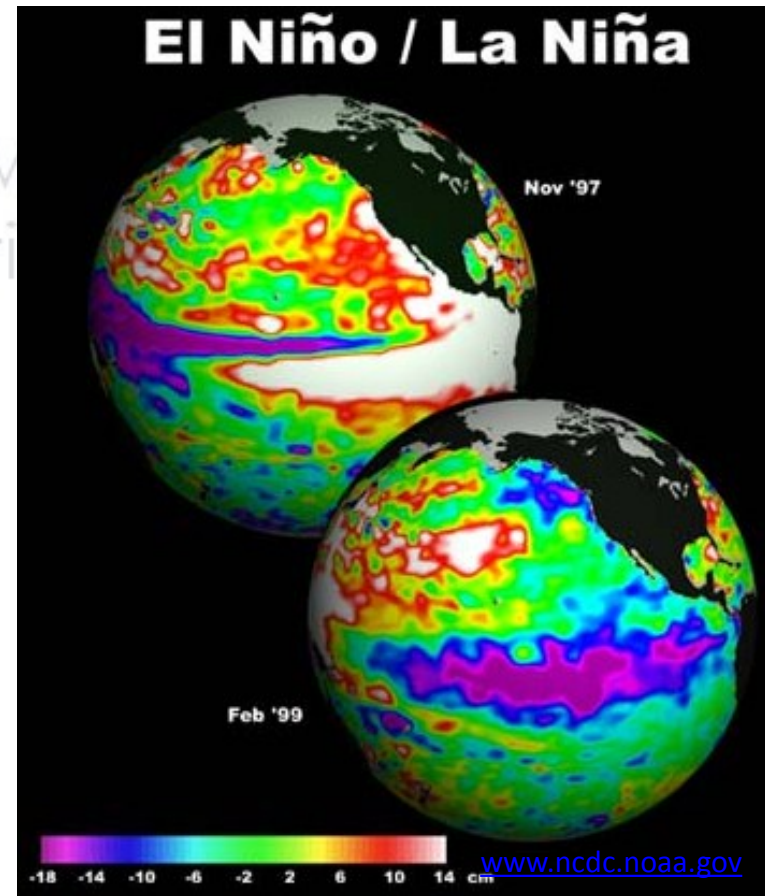
Ocean Interactions with the Atmosphere

La Nina

in Spanish 'the little girl'

occurs when the surface-water temperature in eastern Pacific Ocean becomes unusually cool and westbound trade winds become unusually strong.

La Nina often occurs after an El Nino event

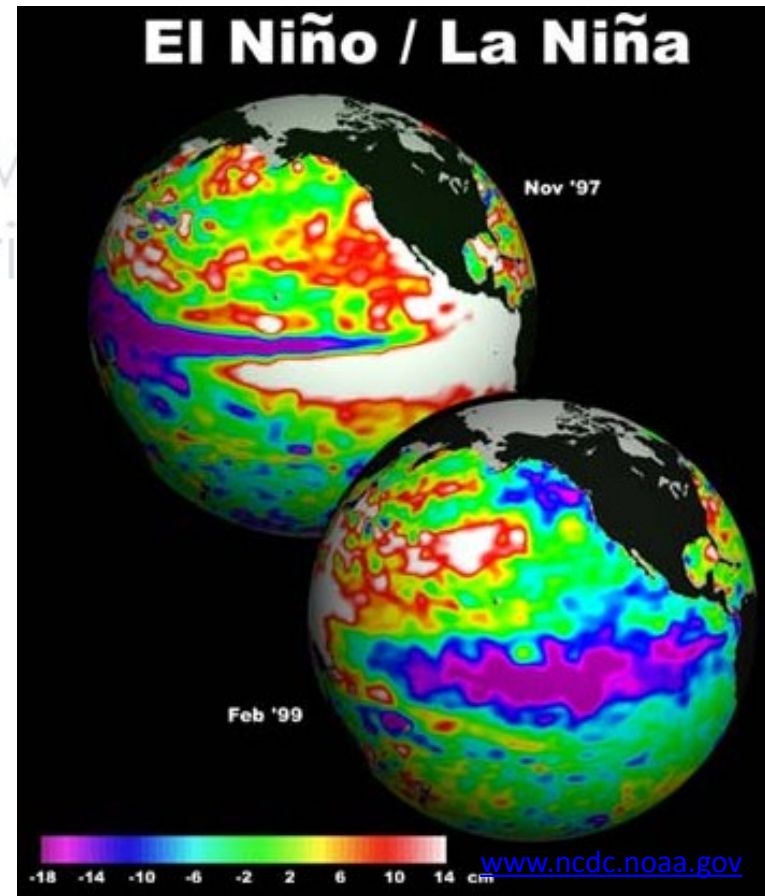




Ocean Interactions with the Atmosphere

During the **spring of 1998**, the surface water of the eastern Pacific cooled 6.7 °C in just 20 days

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Weather and Climate

Weather changes rapidly

Climate usually changes slowly, over hundreds or thousands of years

Weather

Conditions in the atmosphere at a given place and time. It includes

- Temperature
- Atmospheric pressure
- Precipitation
- Cloudiness
- Humidity
- Wind

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Weather and Climate

Typical patterns of weather that occur in a place over a period of years

Two most important factors that determine an area's climate

1. Temperature (average temperature and temperature extremes)
2. Precipitation (average precipitation, seasonal distribution, and variability)

Other climate factors

Wind, humidity, fog, and cloud cover



Weather and Climate

Day-to-day variations

Day-to-night variations

Seasonal variations

Important dimensions of climate that affect organisms

- Latitude
- Elevation
- Topography
- Vegetation
- Distance from the ocean
- Location on a continent or other landmass

Influence temperature, precipitation, and other aspects of climate



Weather and Climate

- Earth has many climates, each is relatively constant for many years
- Organisms have adapted to them

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Wladimir Köppen, A German botanist and climatologist

Developed the most widely used system for classifying climates



Weather and Climate

Wladimir Köppen classification

6 climate zones:

1- Humid equatorial

2- Dry

3- Humid temperate

4- Humid cold

5- Cold polar

6- Highland climate

Each is subdivided into climate types

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Precipitation

Any form of water, such as rain, snow, sleet, and hail, that falls from the atmosphere



Varies from one location to another

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Has a profound effect on the distribution and kinds of organisms present



Precipitation



One of the driest places on Earth
ATACAMA DESERT in CHILE

Average annual rainfall = 0.05 cm

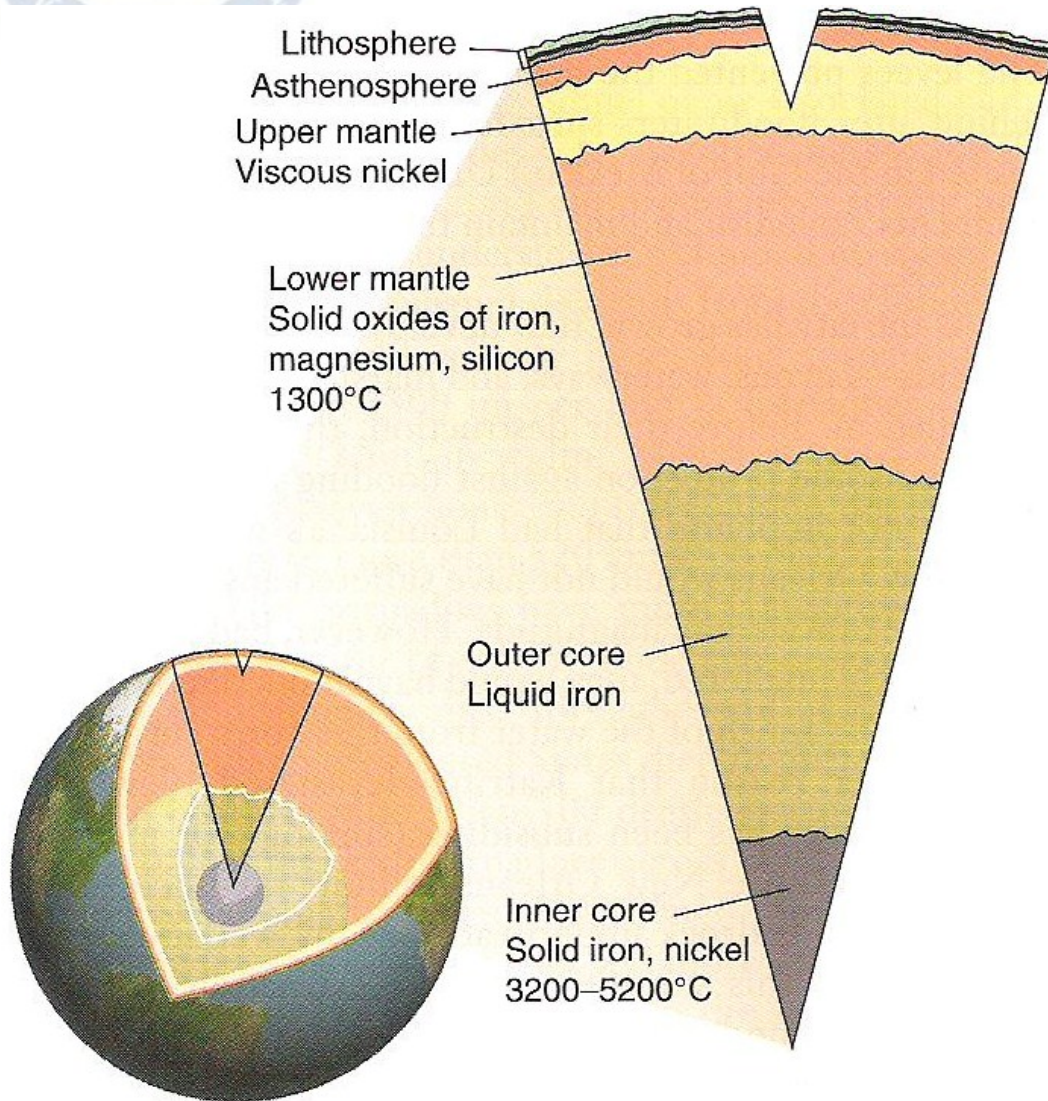


Earth's wettest spot
MOUNT WAIALEALE in HAWAII

Average annual rainfall = 1200 cm



Internal Planetary Processes

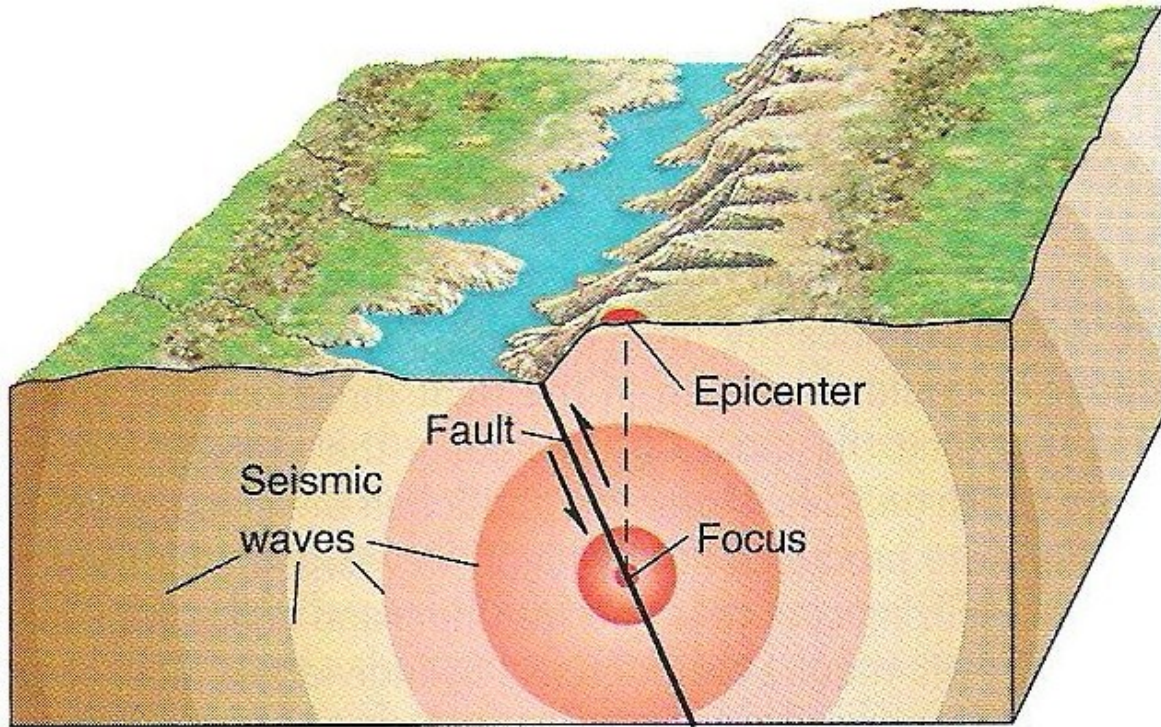


Earth's layers of different composition and rock strength

The Lithosphere
Outermost rigid rock layer



Internal Planetary Processes



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Earthquakes occur when plates along a fault suddenly move in opposite direction relative to each other

Internal Planetary Processes



An aerial photo taken on May 14 shows the road from Dujiangyan city to Wenchuan County in southwest China's Sichuan Province is destroyed by landslide caused by Monday's earthquake. The serious devastation of the road affected the transportation of rescue teams and relief materials to the disaster areas.

Landslide is an avalanche of rock, soil, and other debris that slides swiftly down a mountainside

Landslide: a side effect of earthquakes

In 2008: A powerful earthquake struck in a mountainous area in Sichuan Province, China
Massive landslides and structural collapse of many buildings
About 70,000 people were killed

Internal Planetary Processes



Tsunami, a giant sea wave caused by an underwater earthquake, volcanic eruption, or landslide, sweeps through the water at more than 750 km per hour.

Tsunami: a side effect of earthquakes

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In 2004: Indian Ocean Earthquake & Tsunami

More than 230,000 people in South Asia and Africa were killed

Widespread environmental damage

Salt water moved inland as far as 3 km and polluted soil and groundwater

Internal Planetary Processes



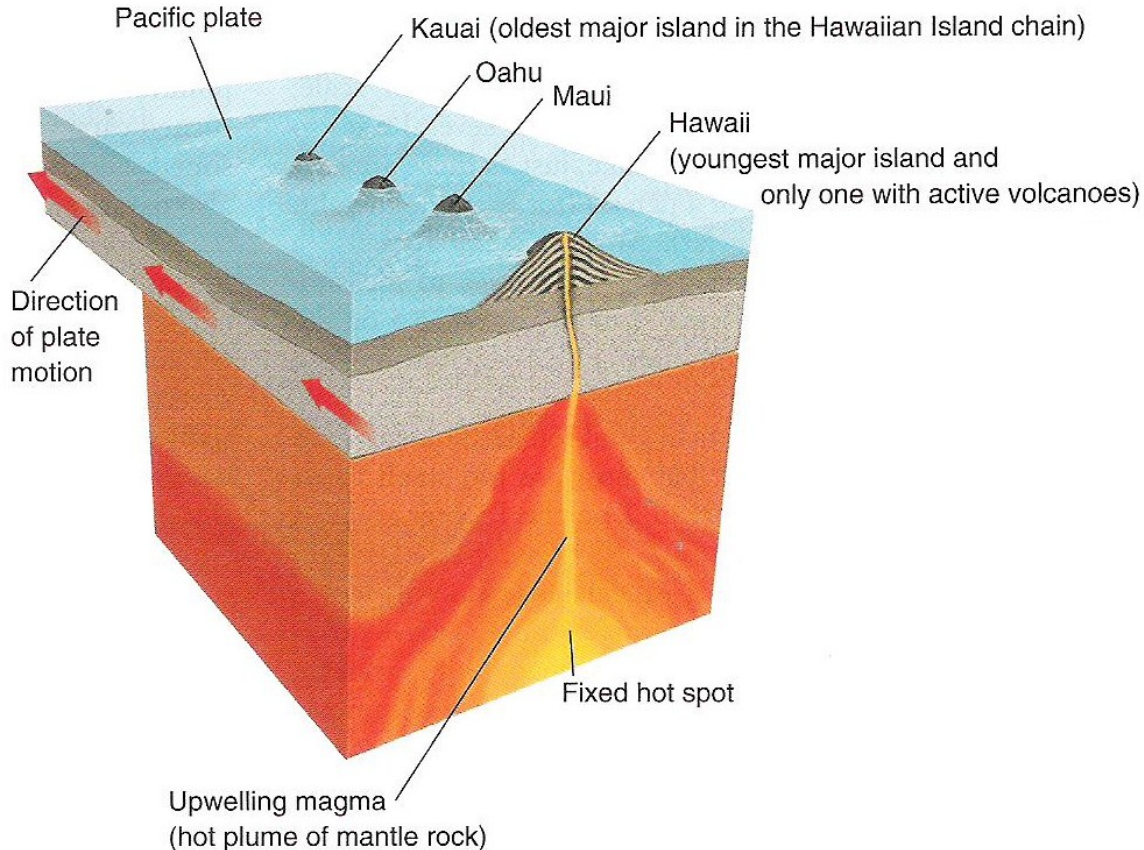
In March 2011: Earthquake in Japan with a magnitude of 8.9, strongest ever recorded in Japan

A disastrous tsunami

Japan lies on a seismically active junction of several tectonic plates



Internal Planetary Processes



Movement of tectonic plates on the hot, soft rock causes most volcanic activity.

In places, the rock reaches the melting point, forming pockets of molten rock, or **magma**.

When one plate slides under or away from an adjacent plate, magma may rise to the surface, often forming volcanoes. Magma that reaches the surface is called **lava**.

Internal Planetary Processes



A huge cloud of volcanic ash and gas rises above Mount Pinatubo, Philippines, on June 12, 1991. Three days later, the volcano exploded in the second-largest volcanic eruption on Earth in this century. Timely forecasts of this eruption by scientists from the Philippine Institute of Volcanology and Seismology and the U.S. Geological Survey enabled people living near the volcano to evacuate to safer distances, saving at least 5,000 lives.

Affect global climate: The magma and ash ejected into the atmosphere when Mount Pinatubo erupted blocked much of the sun's warmth and caused a slight cooling of global temperatures for a year or so.

In 1991: The largest volcanic eruption in the 20th century occurred when Mount Pinatubo in the Philippines exploded.