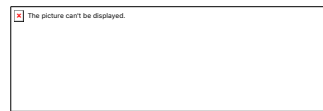


Basics of Climate



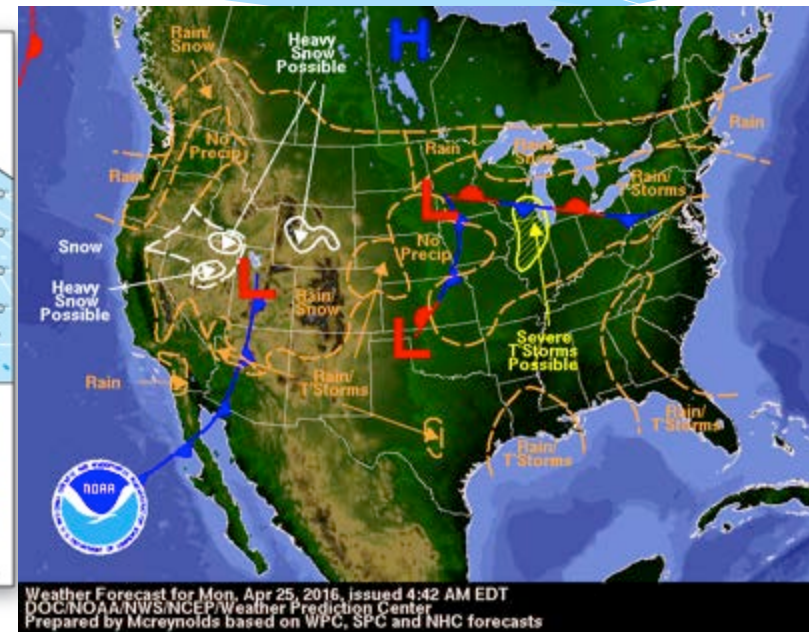
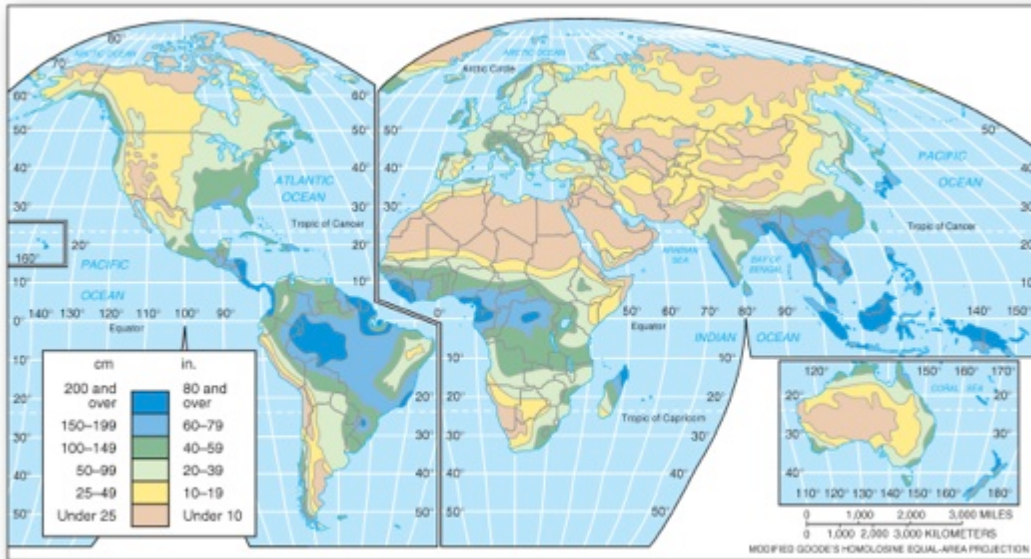
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Weather vs. Climate

Weather is the condition of the atmosphere and surface at any given time.



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Climate is the average condition observed for longer time periods or long term expression of weather, typically calculated for 30-years intervals

Weather vs. Climate

Weather is short term:

- What to wear today?
- Should I bring an umbrella?
- What will the conditions be like tomorrow?
- Is it safe to go out on hiking or up in a balloon?
- Are there flash flood warnings or extreme heat index for today?

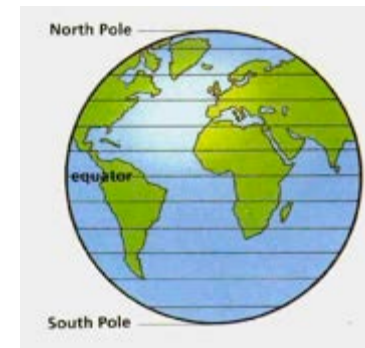
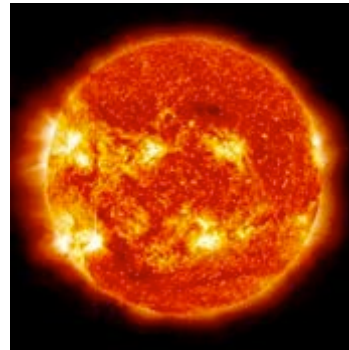


Climate is long term:

- What crops will grow well in this location?
- What kind of clothes should I buy and keep?
- What kind of house should I build or buy?
- Is my home or land in a flood plain and how frequently can you expect floods?

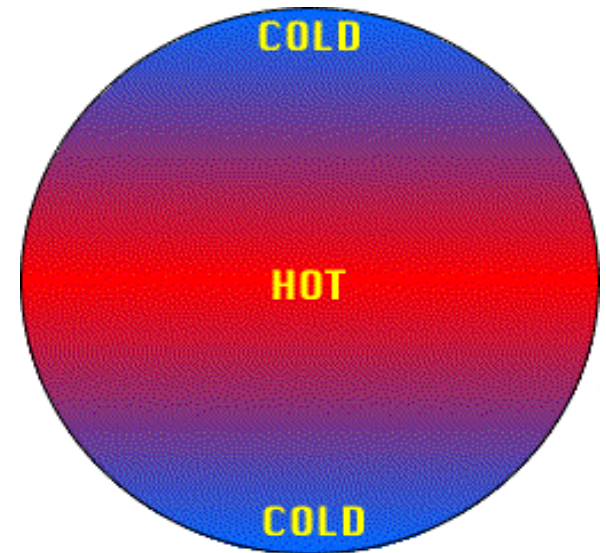
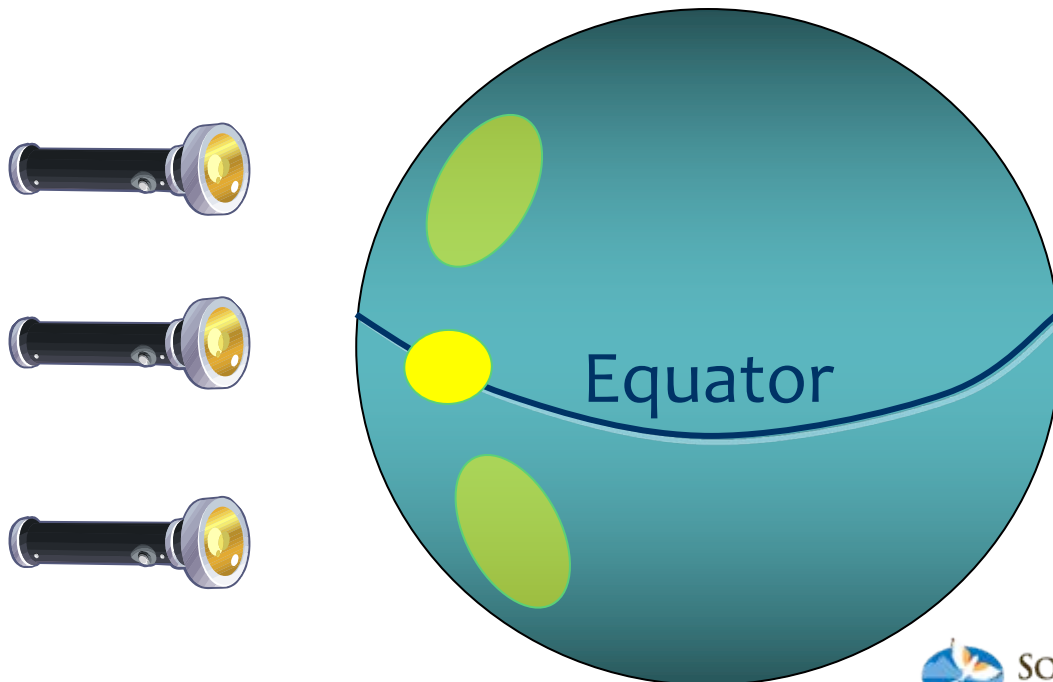
What Determines Climate?

- There are a variety of factors including:
 - The Sun
 - Seasons (tilt)
 - Rotation and Circulation
 - Latitude
 - Altitude
 - Surface Type
 - Atmospheric gases



The Sun

The shape of the Earth causes solar radiation to hit it at different angles and intensities at different locations.



In general: the closer to the equator, the stronger the solar radiation, the greater the heat!

The Great Balancing Act

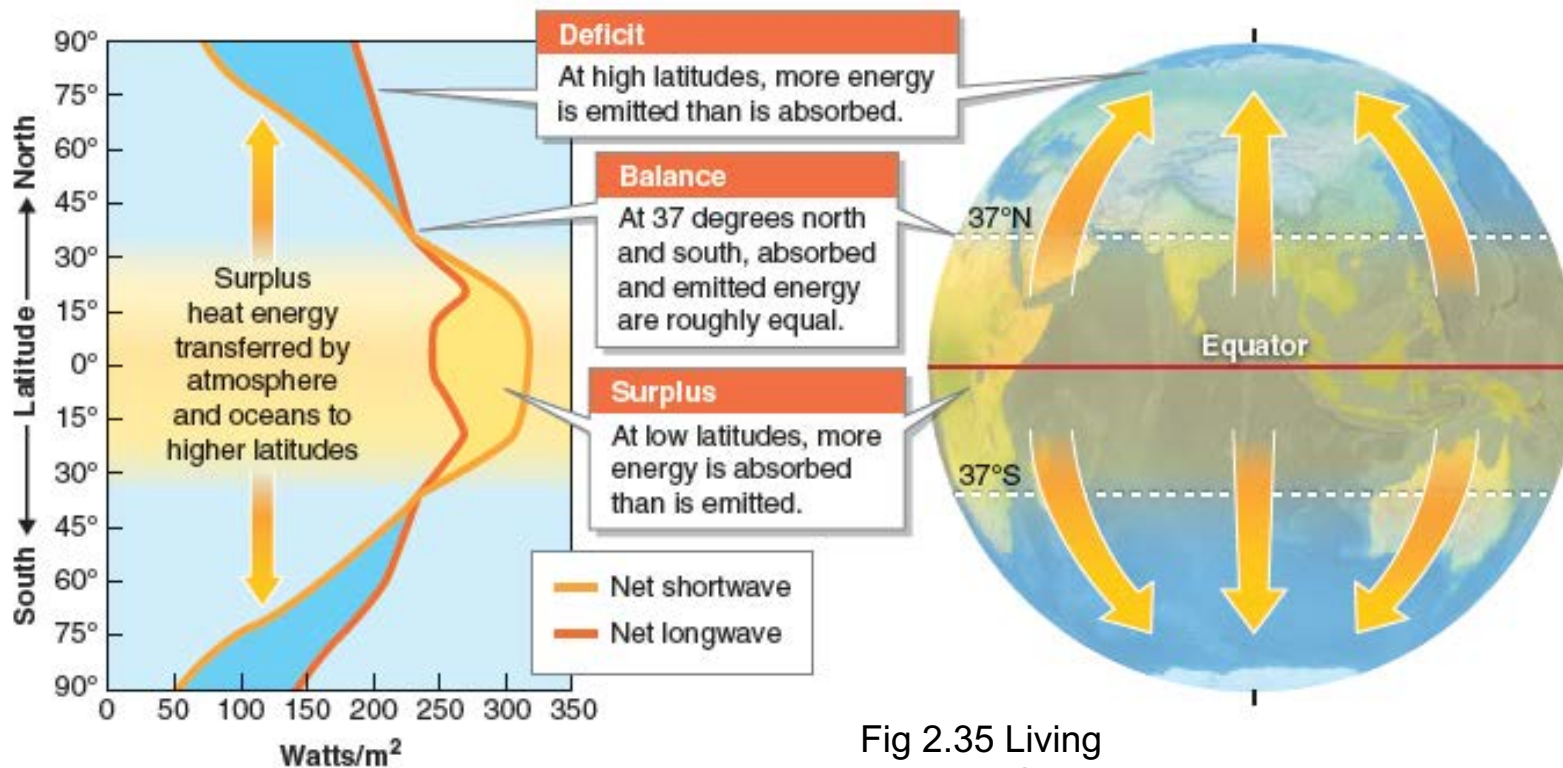
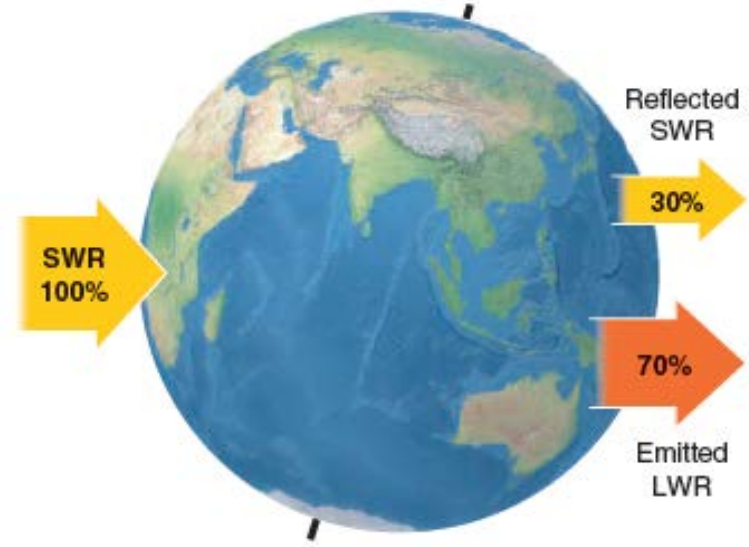


Fig 2.35 Living Physical Geography

What Causes Seasons?

Seasons are caused by tilt of Earth's axis

NOT by the changing distance between Earth and the Sun.

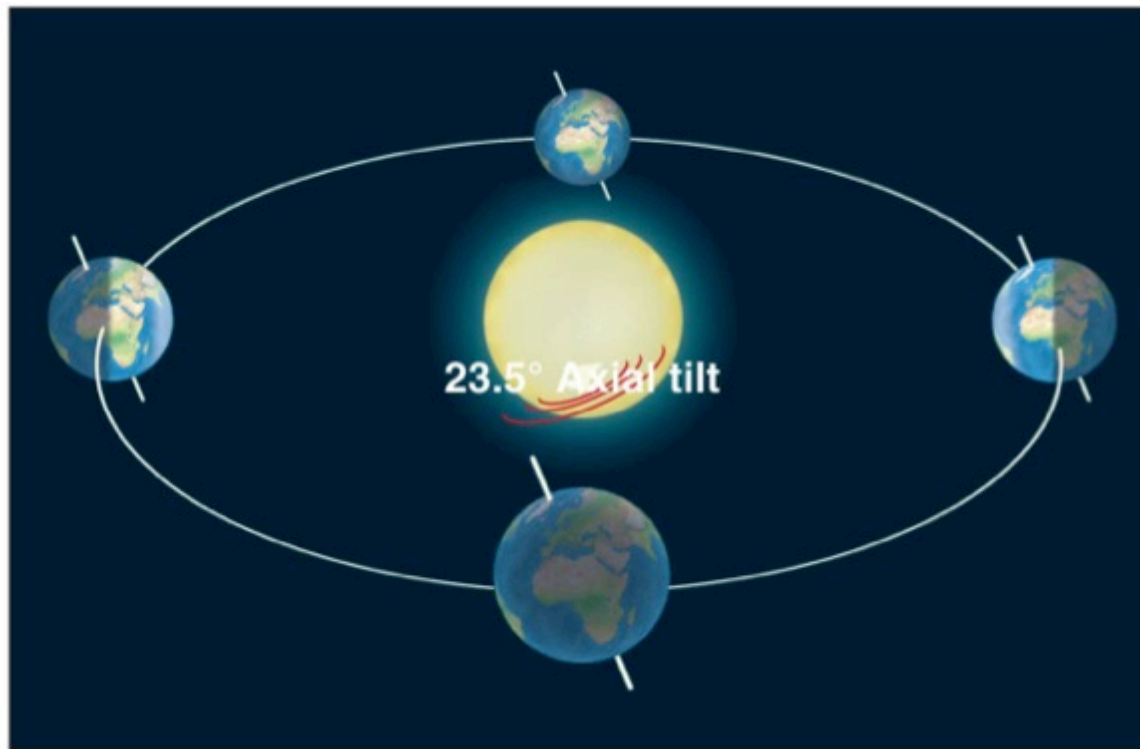
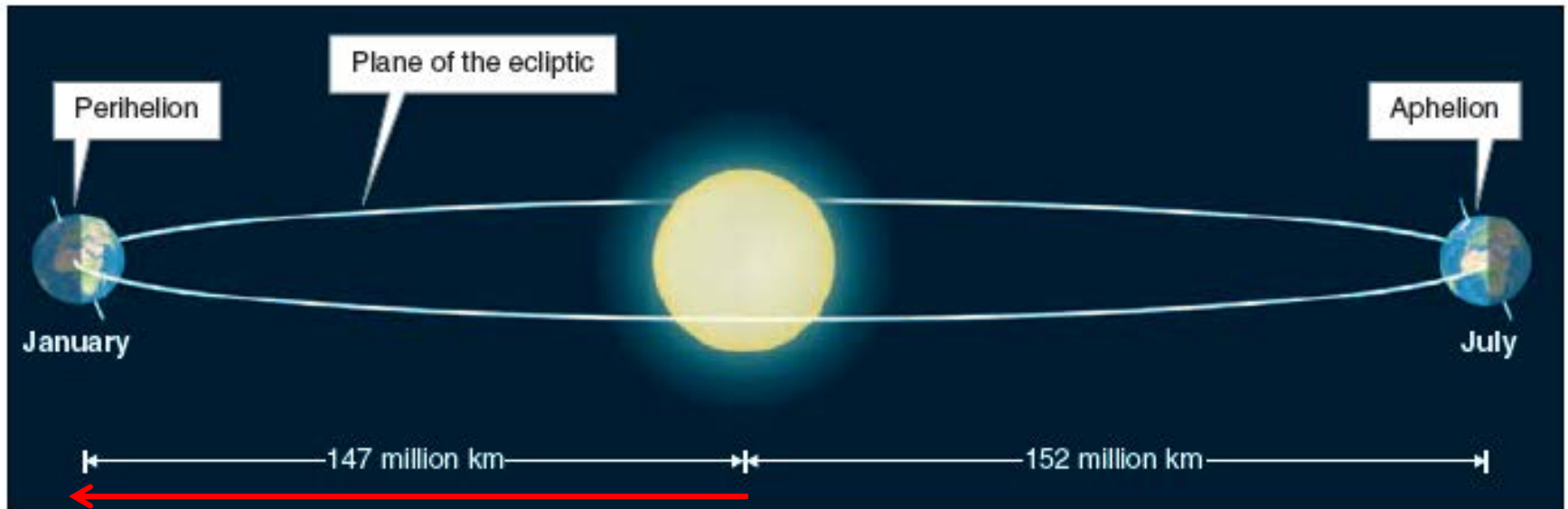
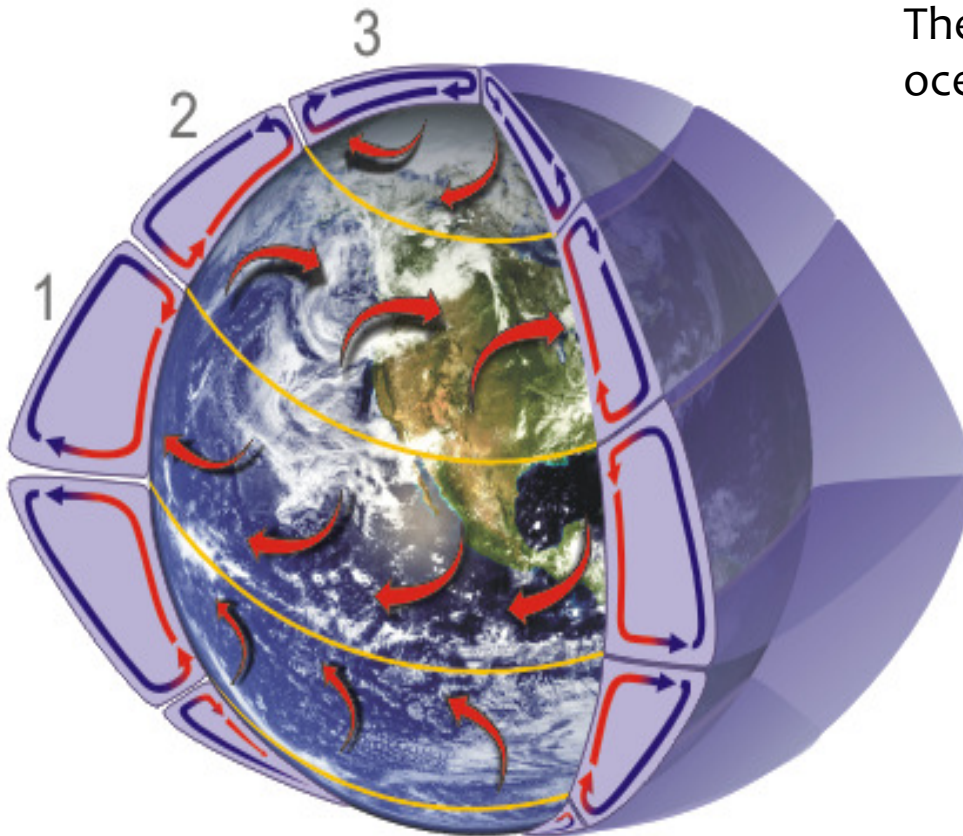


Figure 2.3
Living Physical Geography, First Edition
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Earth is closer to the Sun in January (*perihelion*) than it is in July (*aphelion*).



Rotation and Circulation



The rotation of the Earth causes winds and ocean currents to travel in certain patterns through the atmosphere.

Three major wind circulation belts:

1 - Near equator to $\sim 30^\circ$ N/S latitude (Trade Winds/easterlies)

2 - From $\sim 30^\circ$ to $50-60^\circ$ (westerlies)

3 - Around the poles (N/S of $50-60^\circ$, polar easterlies)

Latitude

Maximum near equator – always warm
Minimum near poles – always cold

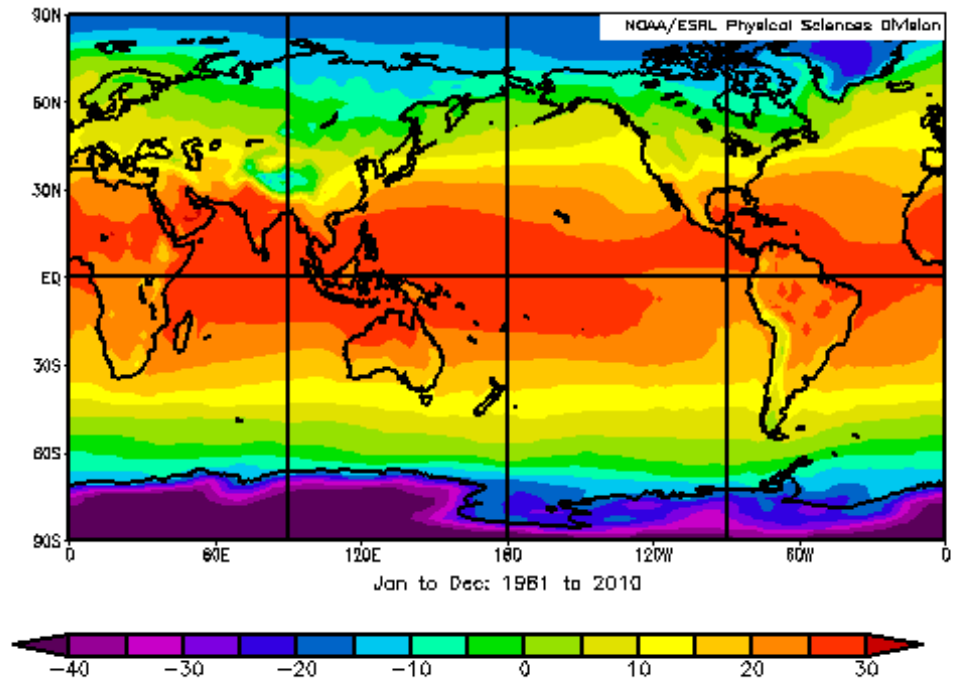
Variation in the amount of sunlight reaching the Earth's surface affects temperature at different latitudes

In general, the closer to the equator, the less temperature variability seen year-round.

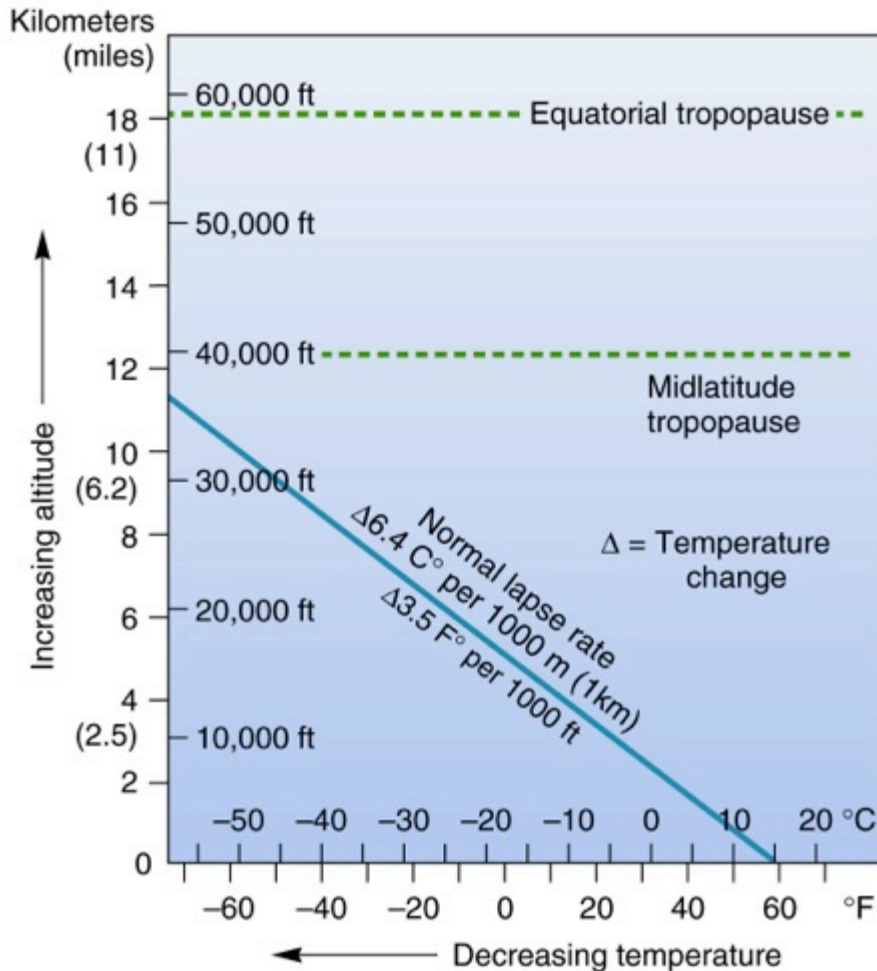
New Mexico average temperature: 50°F
July 65°F , January 35°F

Alaska average temperature: 37°F
July 52°F , January 17°F

Mean surface temperature ($^{\circ}\text{C}$) Jan to Dec, 1981-2010.



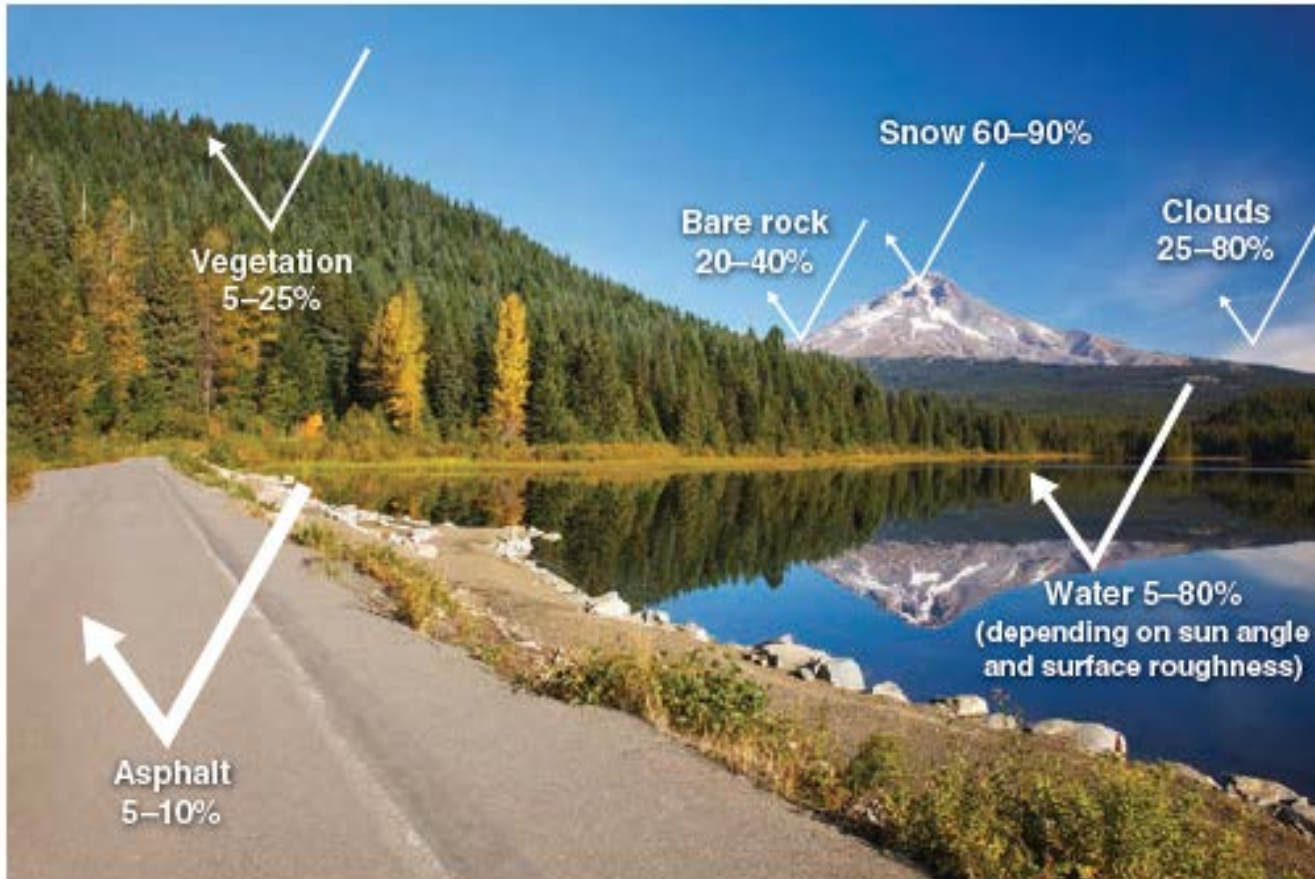
Altitude and Elevation



The higher the altitude, the colder its temperature.

On average, temperature drops $\sim 3.5^{\circ}\text{F}$ every 1000 ft of elevation.

Surface Type



Albedo or brightness
Is the Reflective
quality of a surface.
Expressed as a %,
percent of insolation
reflected

Earth's Energy Balance

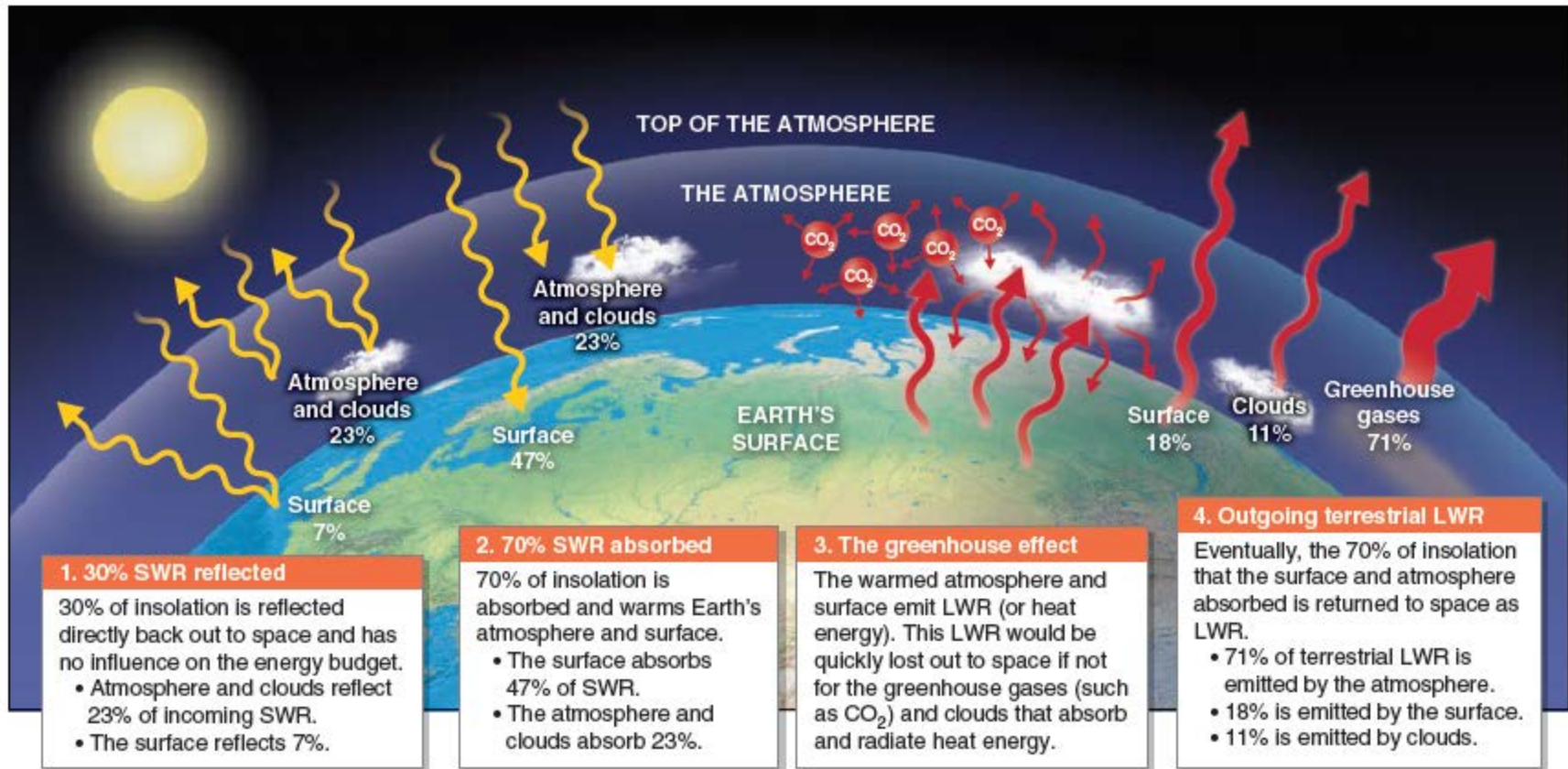
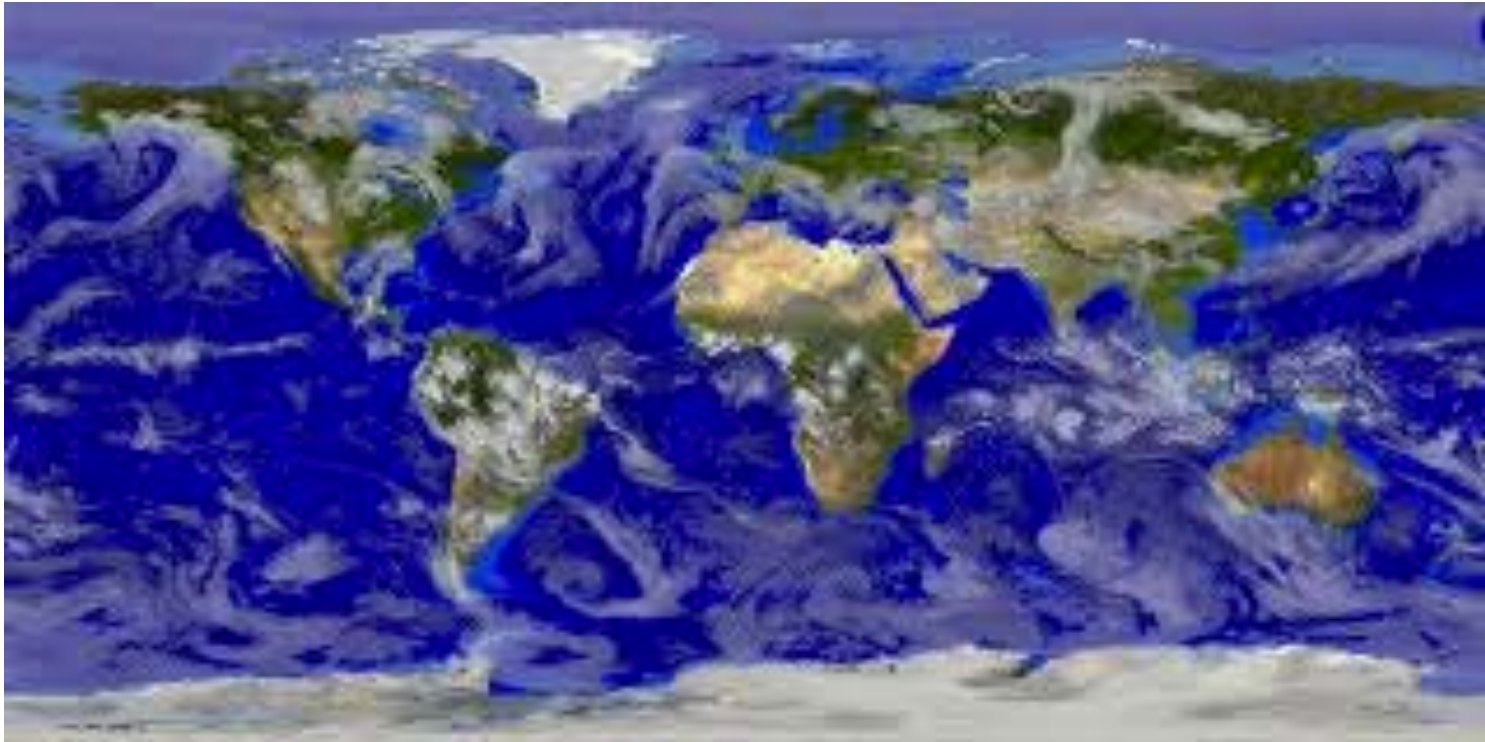


Fig 2.35 Living Physical Geography

Without any greenhouse gases, Earth's lower atmosphere would be much colder (inhospitable to most life).

Weather Patterns

The combination of all of the previously mentioned inputs creates weather patterns, including jet streams, convergence zones, and teleconnections.



Jet Streams

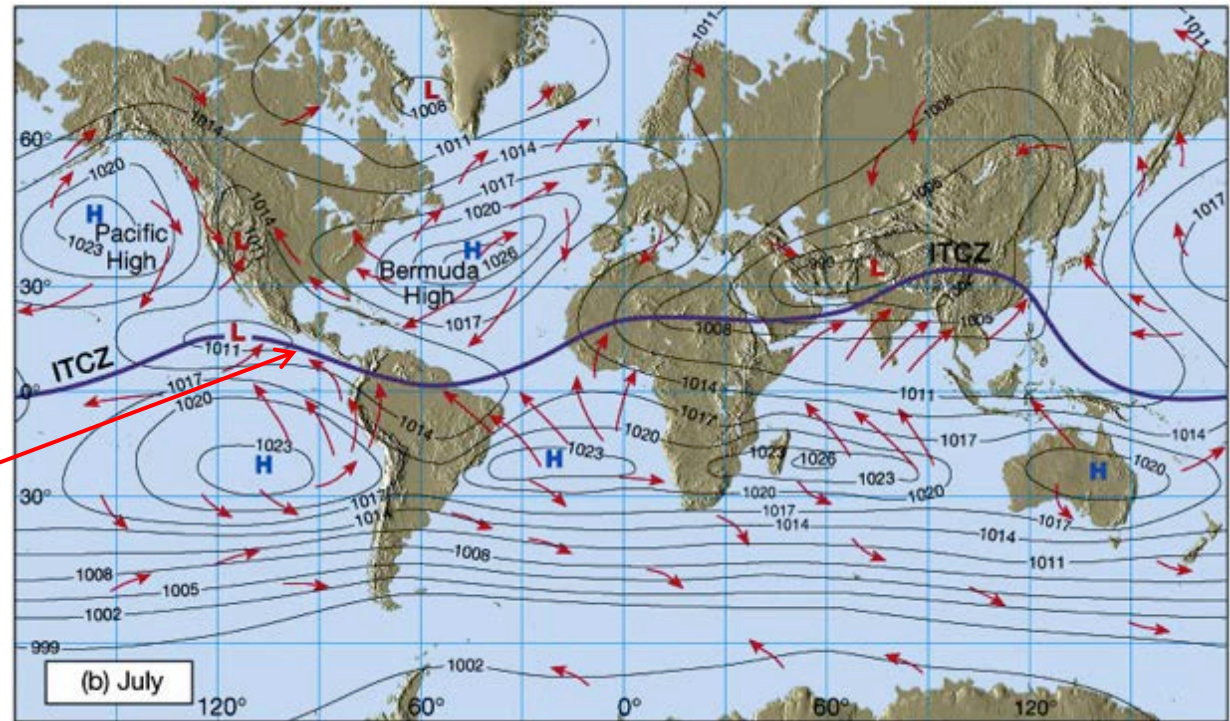
Narrow bands of wind in the upper atmosphere.
Generally blow west to east, but can shift north and south.
Tends to follow temperature boundaries between circulation cells.



Convergence Zones

Convergence zones are places where different pressure gradients meet. They can be localized or cover the entire Earth.

The largest is the Intertropical Convergence Zone (ITCZ) that encircles the Earth.



Teleconnections

El Niño Teleconnections

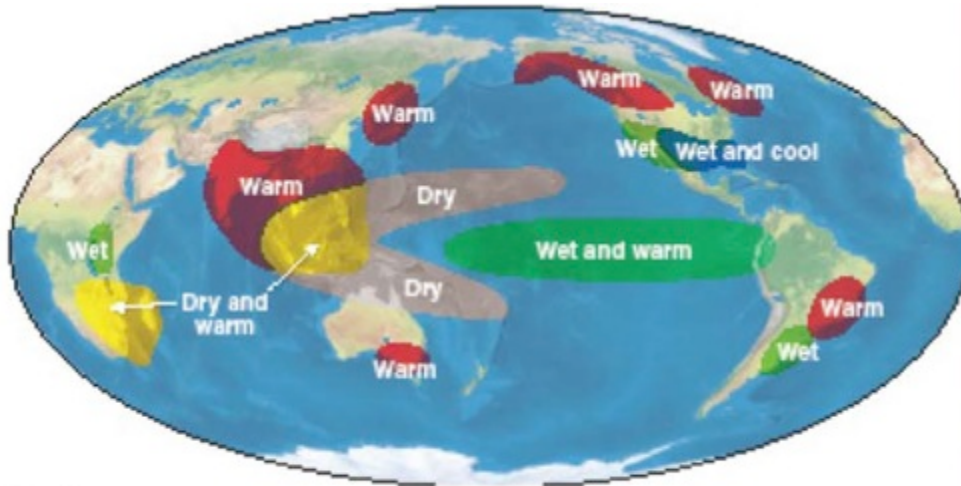


Figure 5.25
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During El Niño years, New Mexico tends to experience wetter conditions and drier conditions during La Niña years.

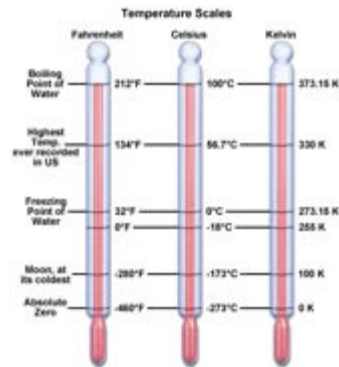
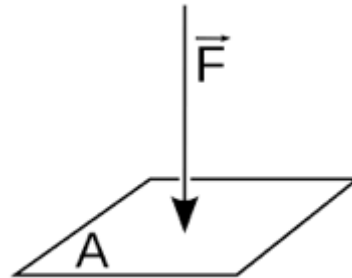
Teleconnections are shifts in climate that influence places across great distances. Examples include:

- El Niño – Southern Oscillation (ENSO)
- Atlantic Multidecadal Oscillation (AMO)
- Arctic Oscillation (AO)
- Pacific Decadal Oscillation (PDO)
- And others!

Observing Variables

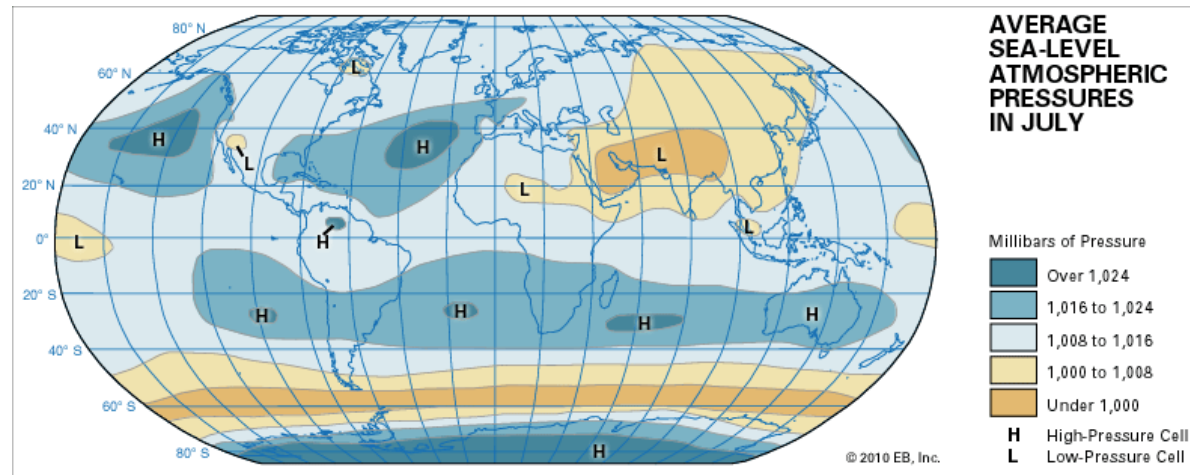
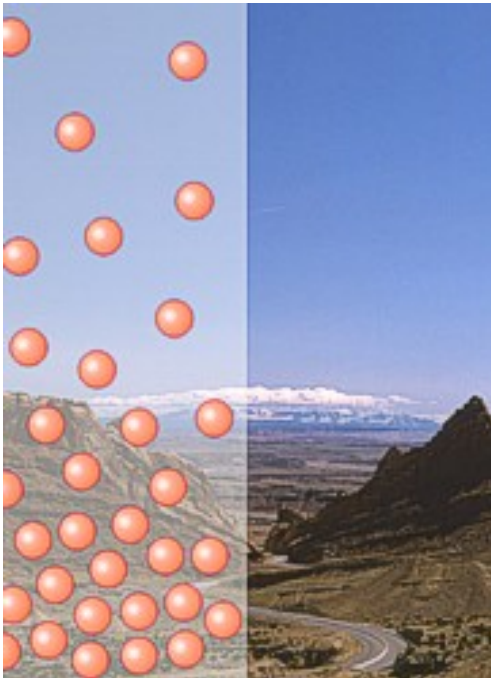
We study weather and climate by using instruments to make observations and that measurements including :

- Pressure
- Temperature
- Moisture
- Wind
- Solar Radiation
- Precipitation



Pressure

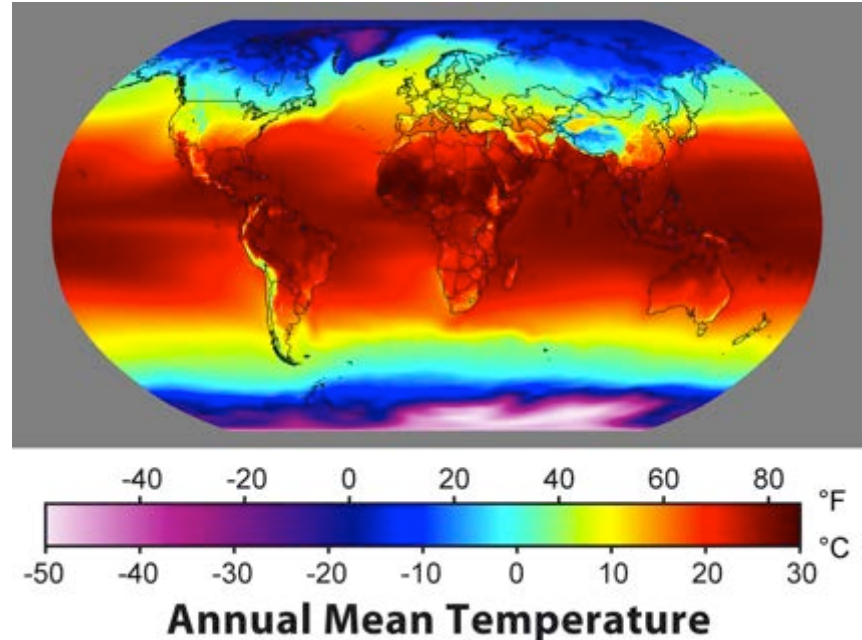
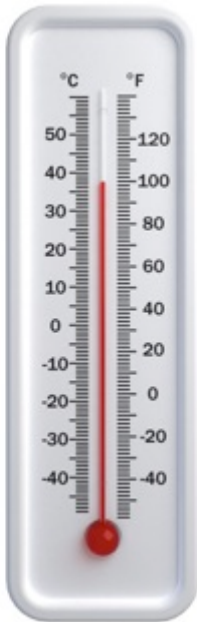
Atmospheric pressure represents the weight of air molecules pressing on a surface.



In general,
higher pressure = fairer weather,
lower pressure = stormier weather

Temperature

Temperature is a measure of the energy content of air in terms of the movement of molecules (it is not heat).



Temperature can affect pressure and moisture in the atmosphere and vice versa.

Moisture

Moisture is water vapor in the atmosphere is measured by dewpoint and relative humidity.

Dewpoint is the temperature at which air becomes saturated and water condenses on a surface.

Relative humidity is the ratio of water in the air to the maximum amount of moisture in saturated air. Higher temperatures hold more water vapor than colder temperatures.



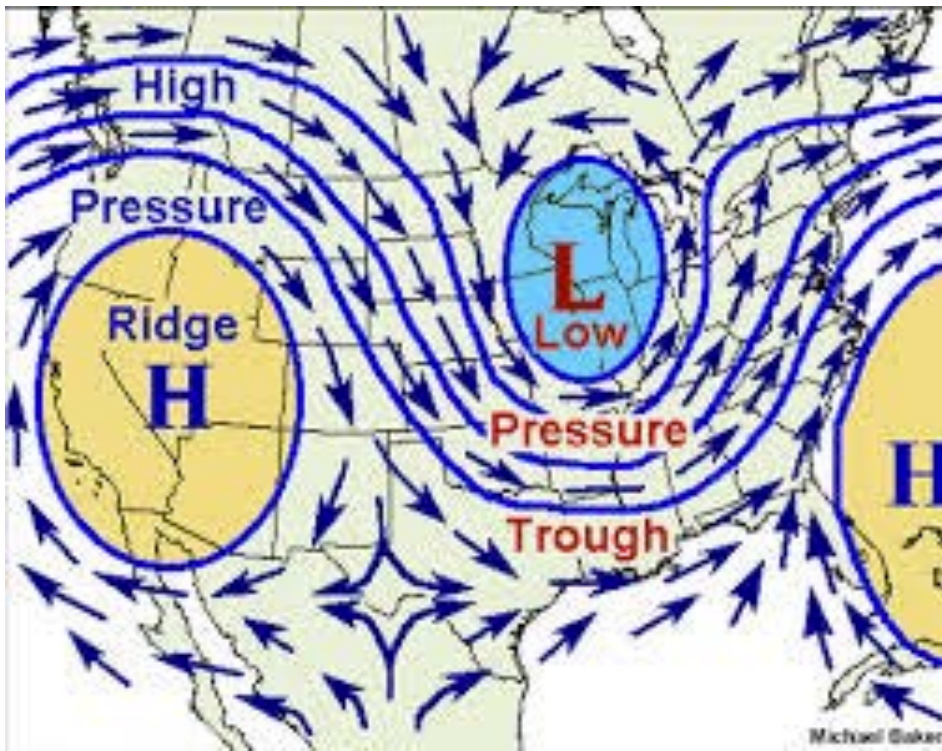
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Wind



Wind is air in motion relative to the Earth's surface, and results from pressure differentials.

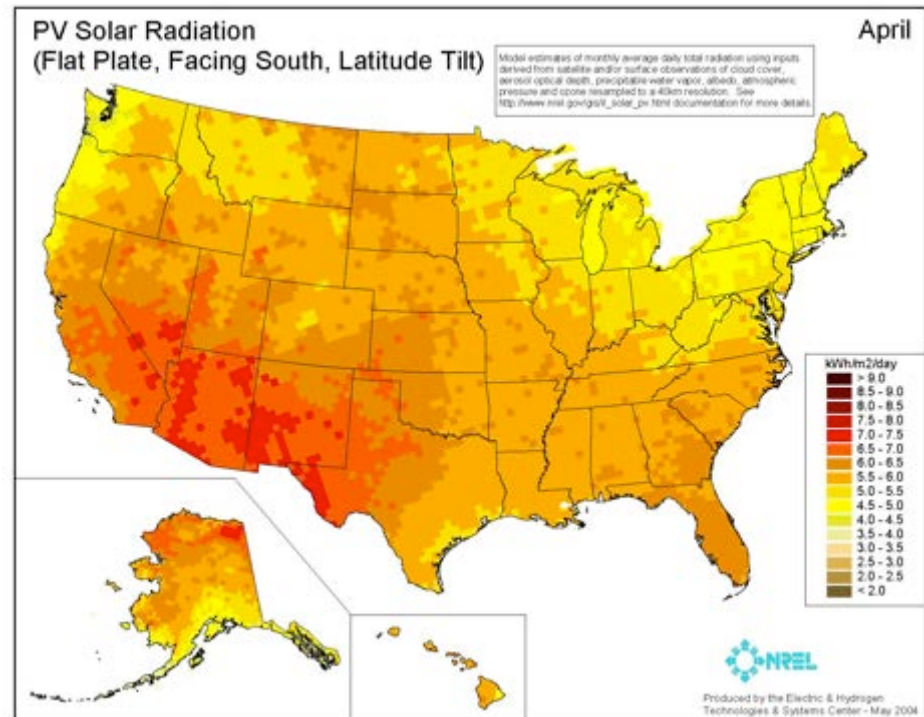
Think of wind in terms of a pump: it moves from areas of high to low pressure.

www.meted.ucar.edu

Solar Radiation

Incoming radiation or energy from the Sun.

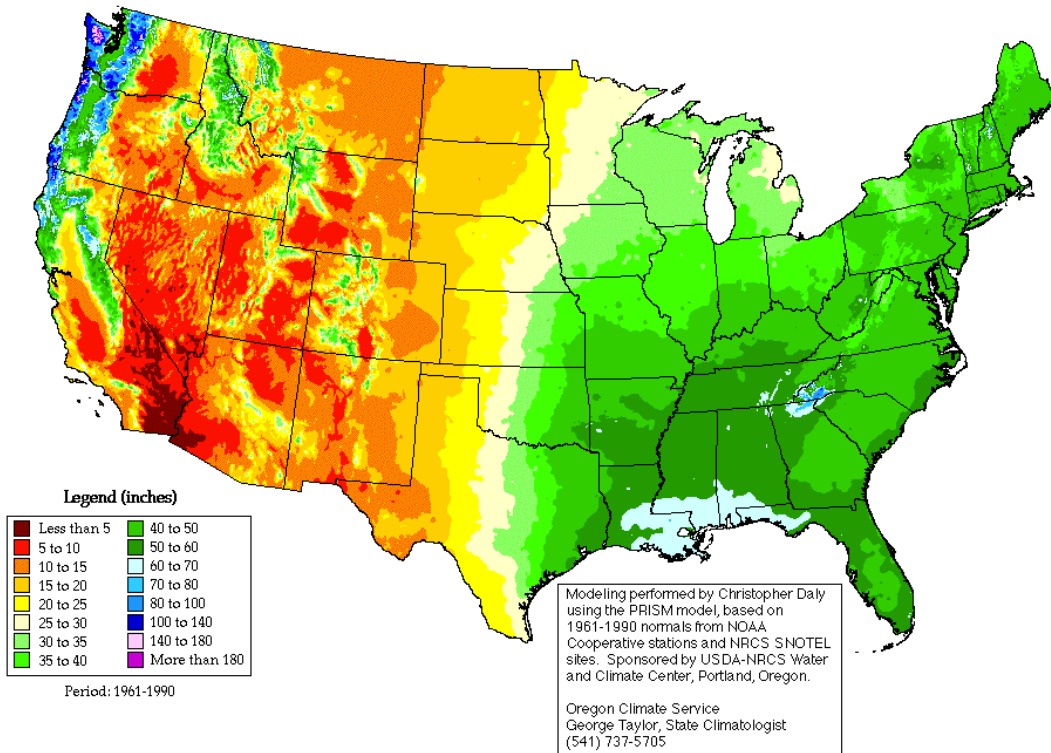
It either is absorbed in the atmosphere, scatter in atmosphere, or reaches the surface where it can be by a reflected or absorbed.



Precipitation

Annual Average Precipitation

United States of America



Water in the form of snow, rain, sleet, ice, hail, etc.

Result of certain temperature, water vapor, and pressure conditions in the atmosphere.

Influenced also by geography.