

# Wind and Atmospheric Circulation

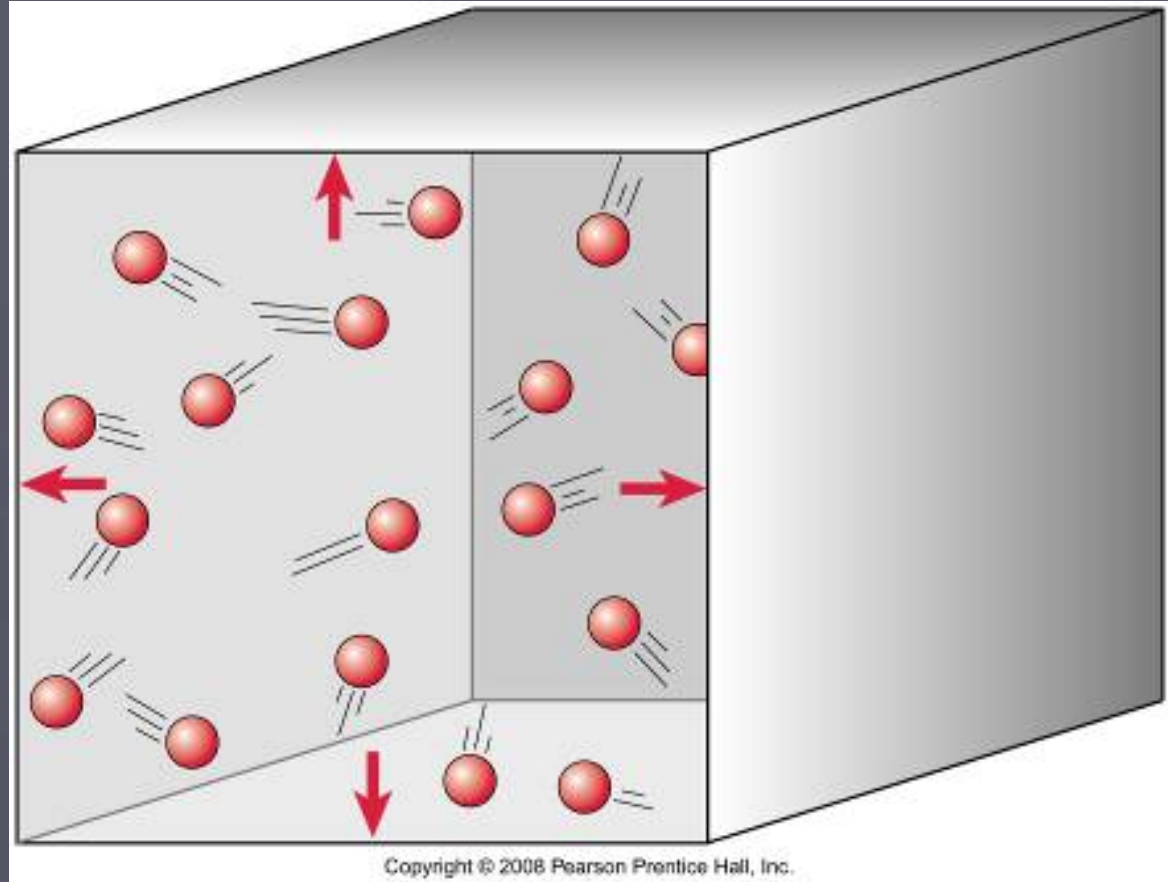
Chapter 5: Atmospheric and Oceanic Circulation

# Factors that affect wind

- Gravity
- Pressure Gradient Force
- Coriolis Effect
- Friction
- Physical Features of the Earth

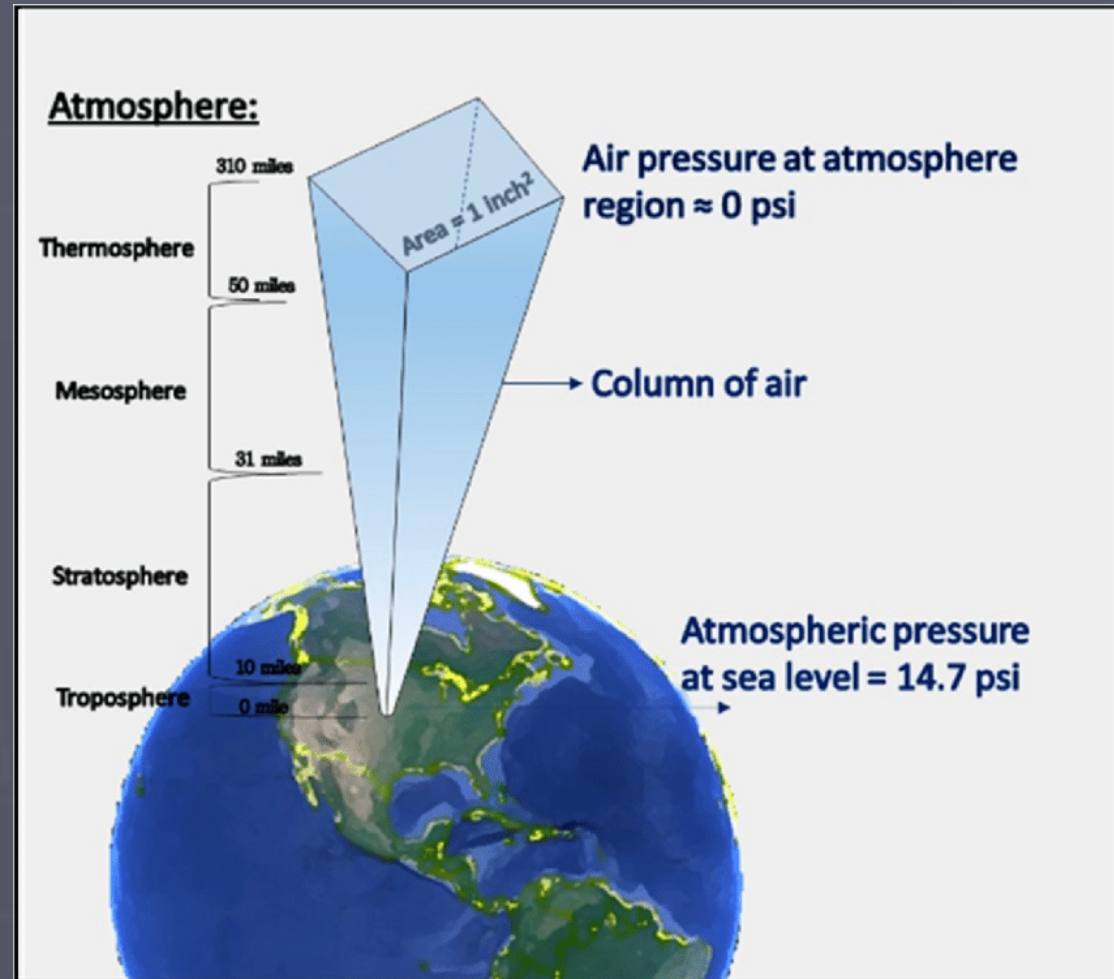
# Understanding Atmospheric Pressure

- Air is a gas
  - Motion and collision of gas molecules create pressure
  - Pressure is the force exerted by gas molecules
- **General Principle – Air moves from areas of high pressure to low**



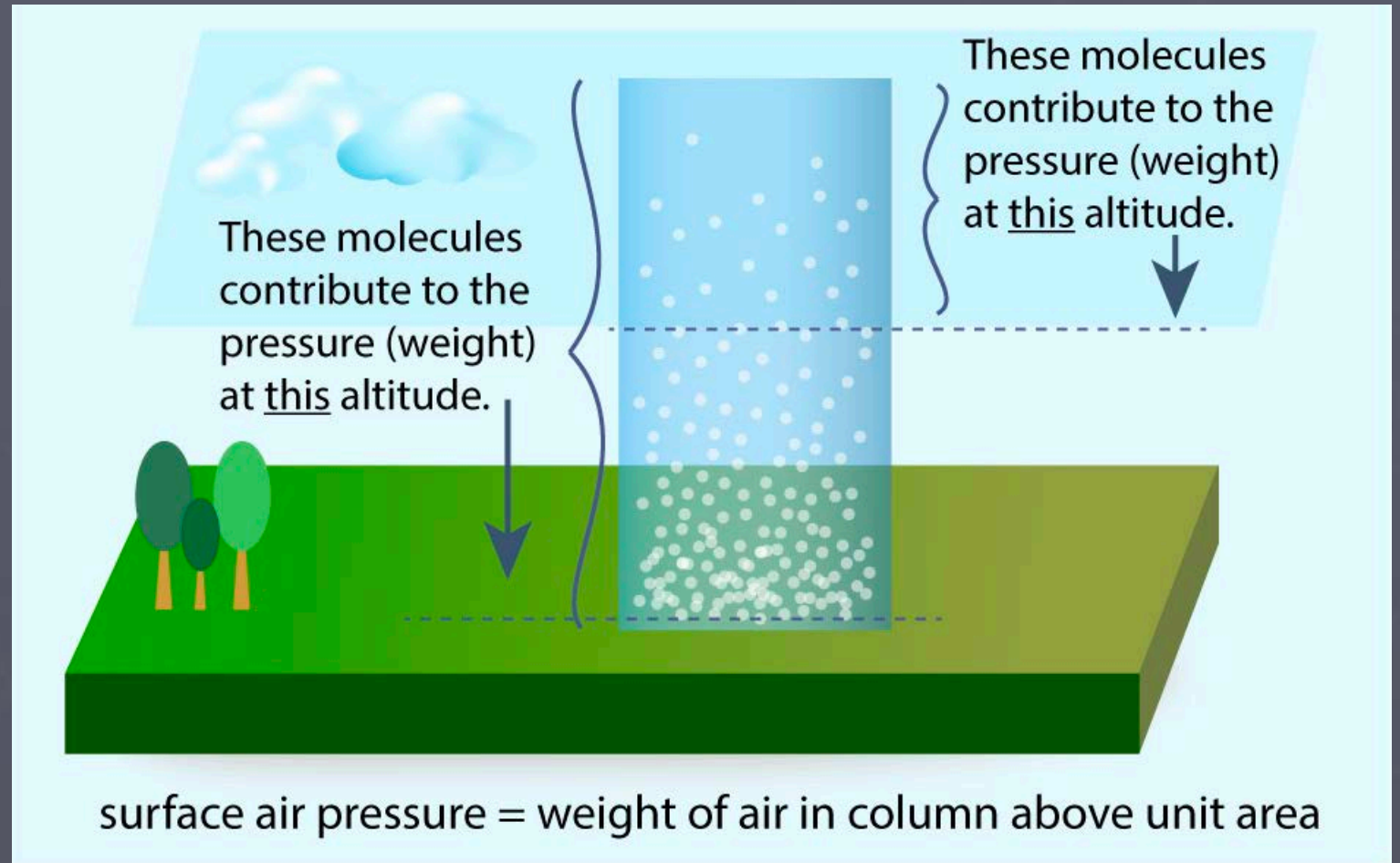
# Atmospheric Pressure

- Air is constantly pushing down to the Earth's surface
  - Air pressure is highest at sea level
  - Standard air pressure is 14.7 lbs per square inch



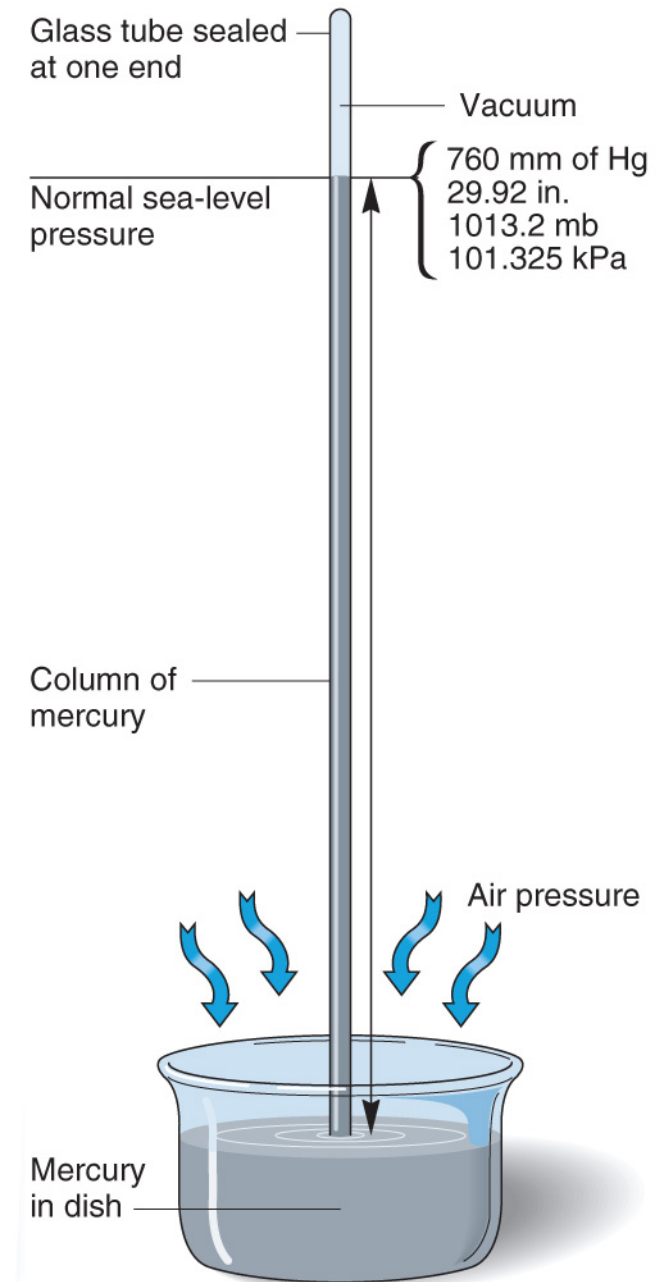
# Atmospheric Density and Altitude

Density: The amount of matter in a given unit



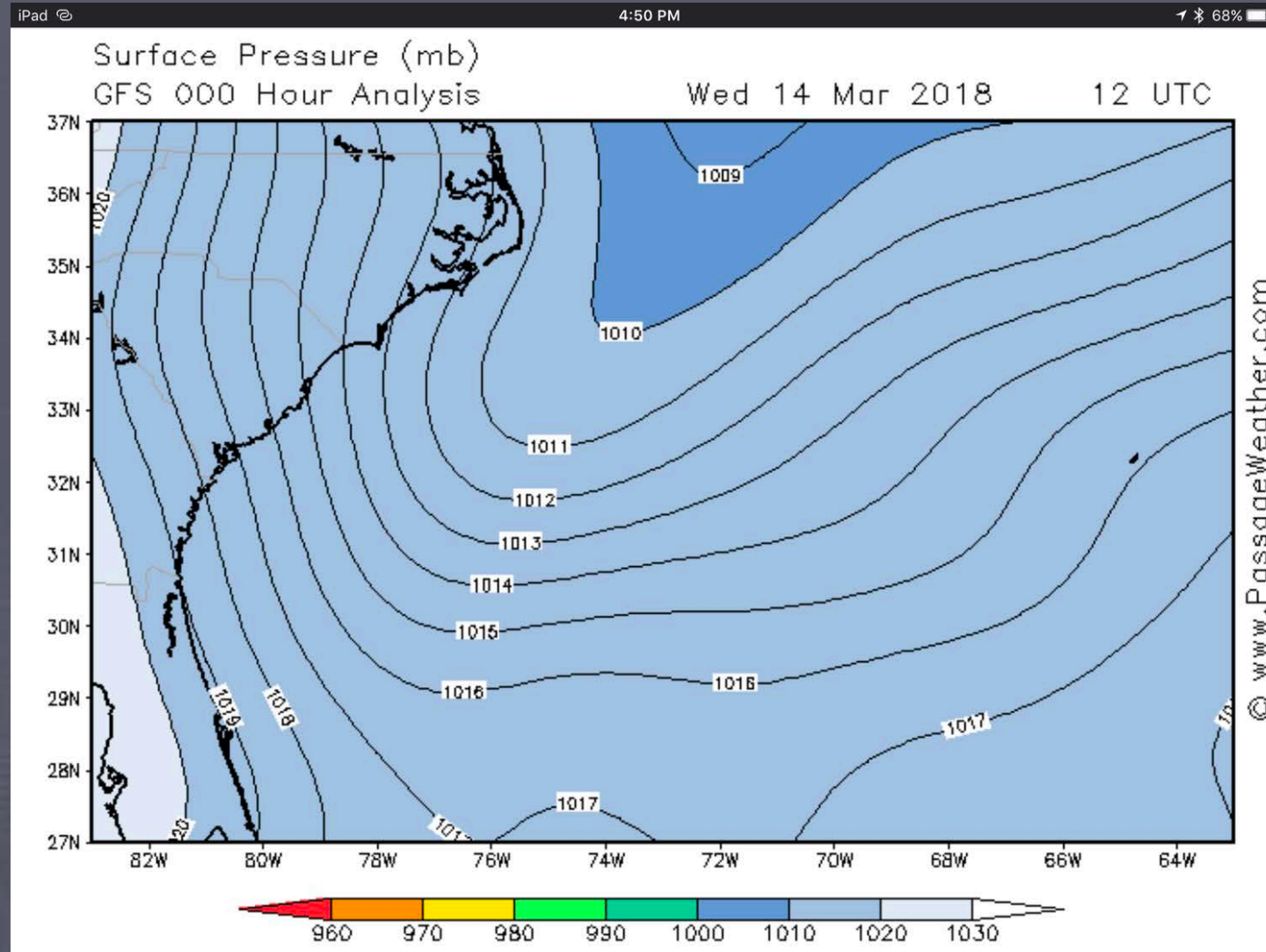
# Atmospheric Pressure

- Barometric pressure
  - Using a barometer you can measure changes in Atmospheric pressure
    - Using set of known variables



(b)

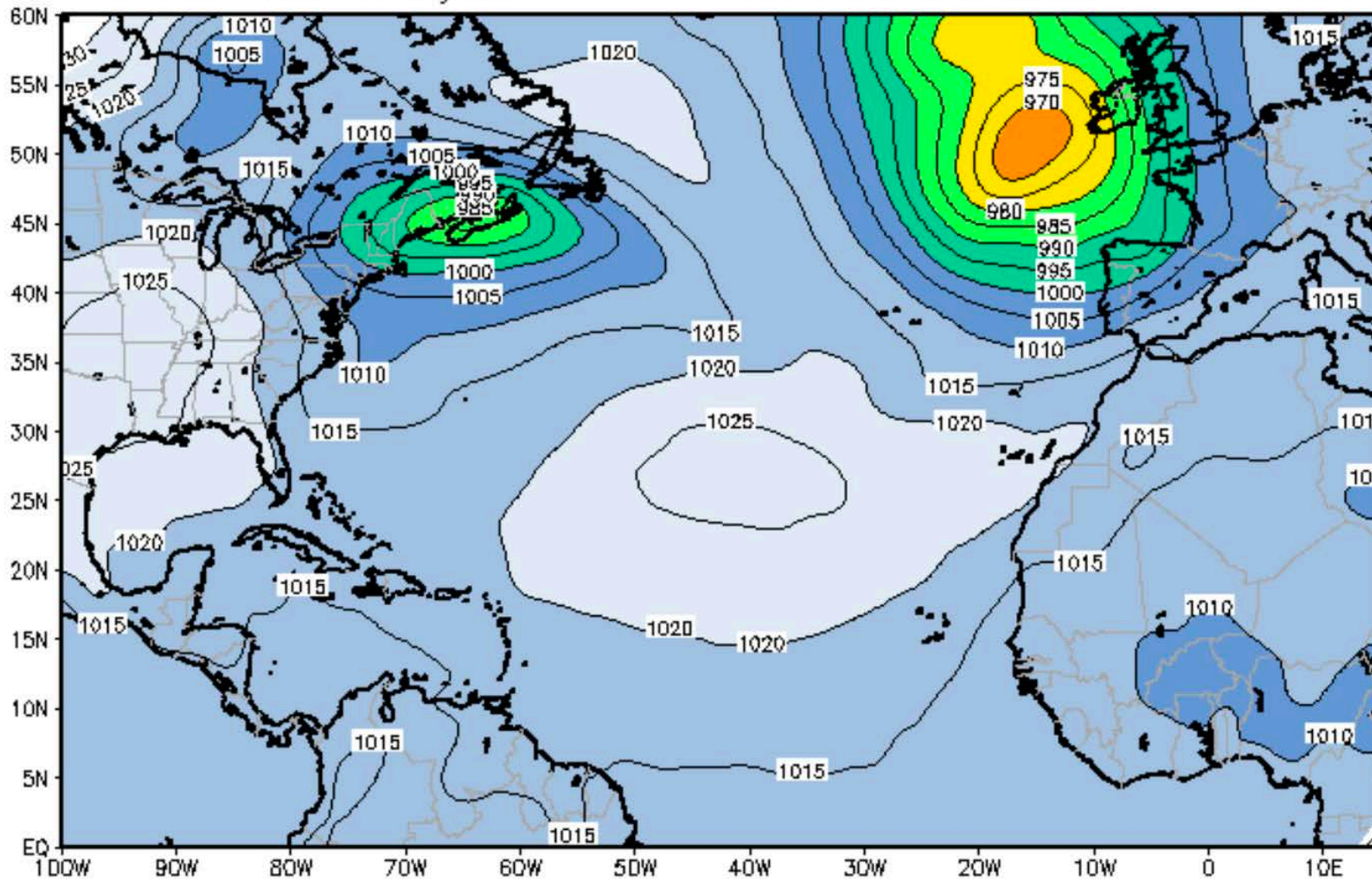
# Mapping Air Pressure: Isobar



# Surface Pressure (mb) GFS 000 Hour Analysis

Wed 14 Mar 2018

12 UTC

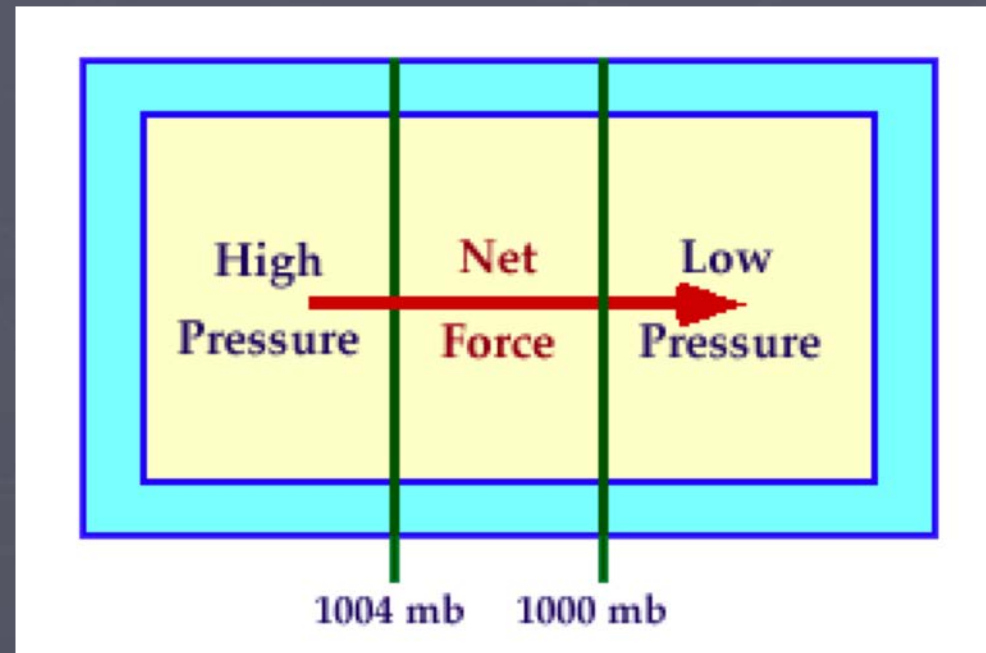


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# Pressure Gradient Force

- Wind is the result of air moving horizontally along the earth's surface
  - Moving from areas of high pressure to low pressure
- Caused by unequal heating of the earth's surface



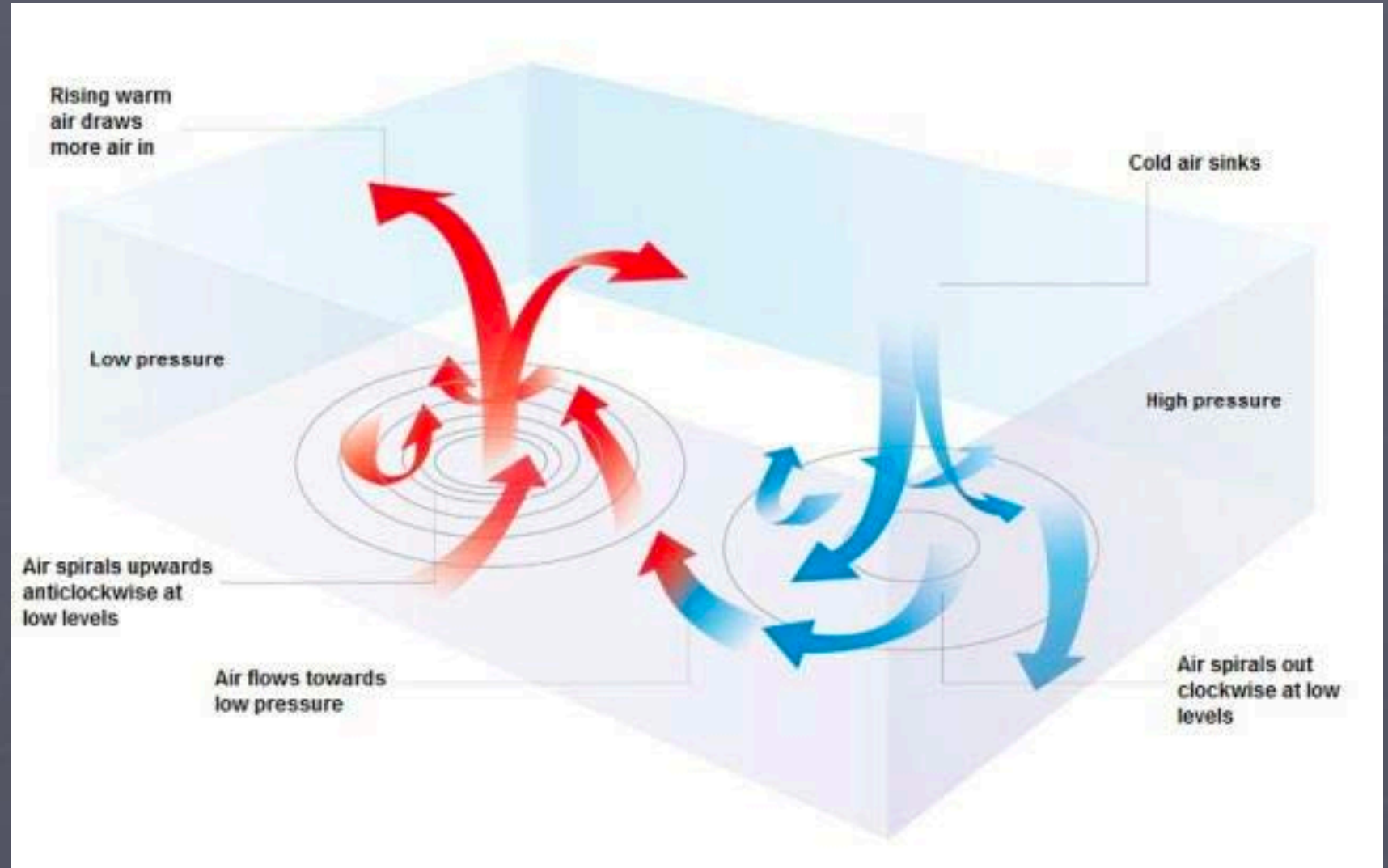
# Cyclone and Anticyclone

**Cyclone:** low-pressure cell

Air converges and ascends

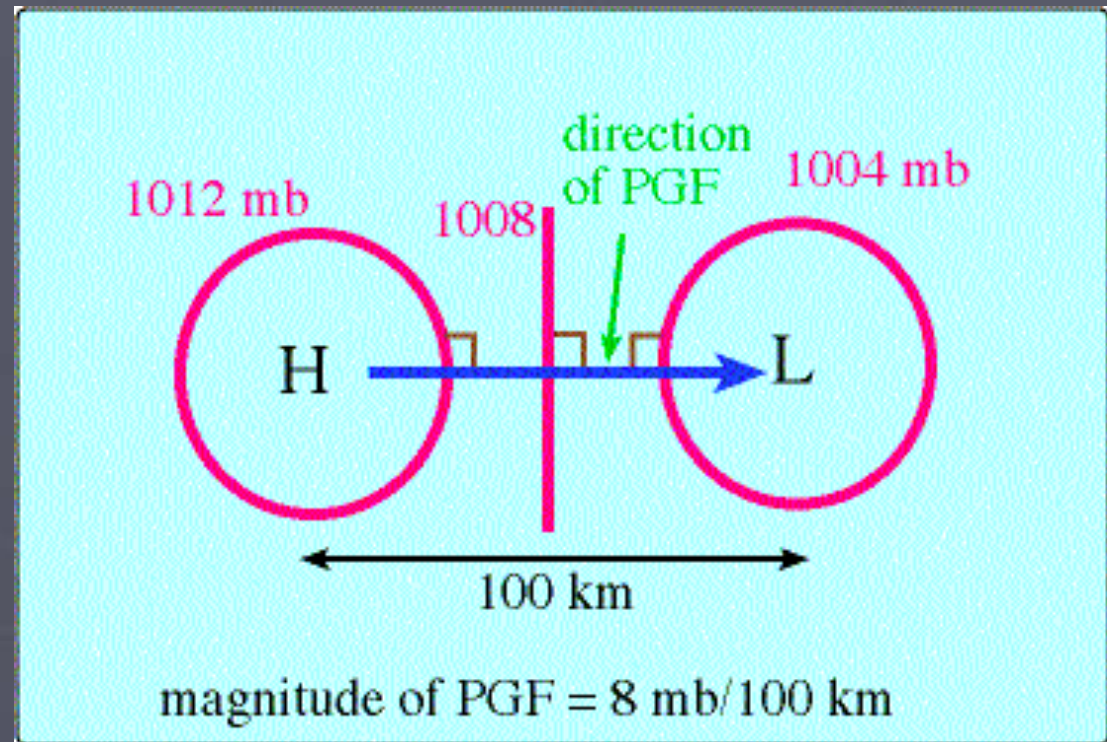
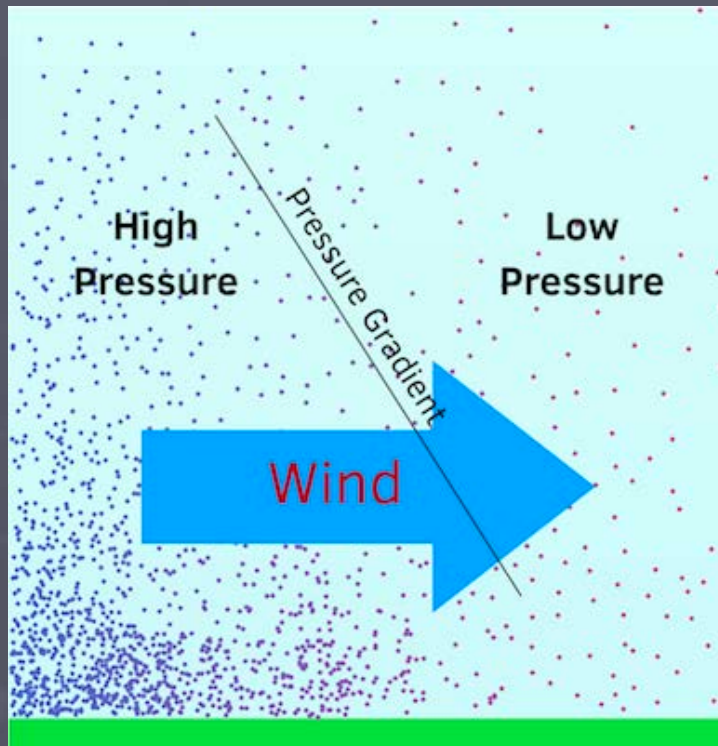
**Anticyclone:** high-pressure cell

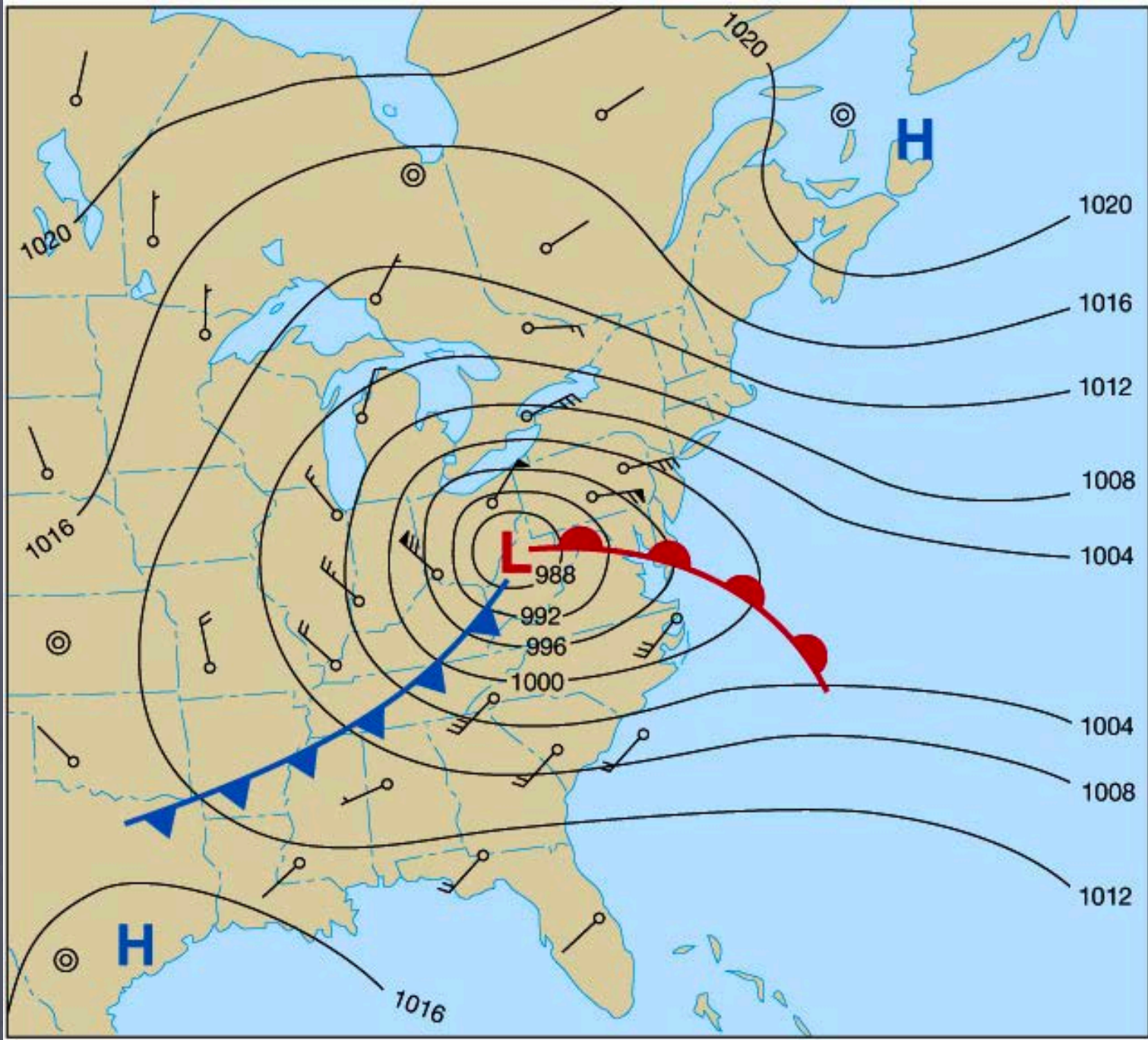
Air descends and diverges



# PGF and wind velocity

- The larger the pressure gradient the higher the wind velocity
- Heavier air remains closer to earth's surface as warmer air rises

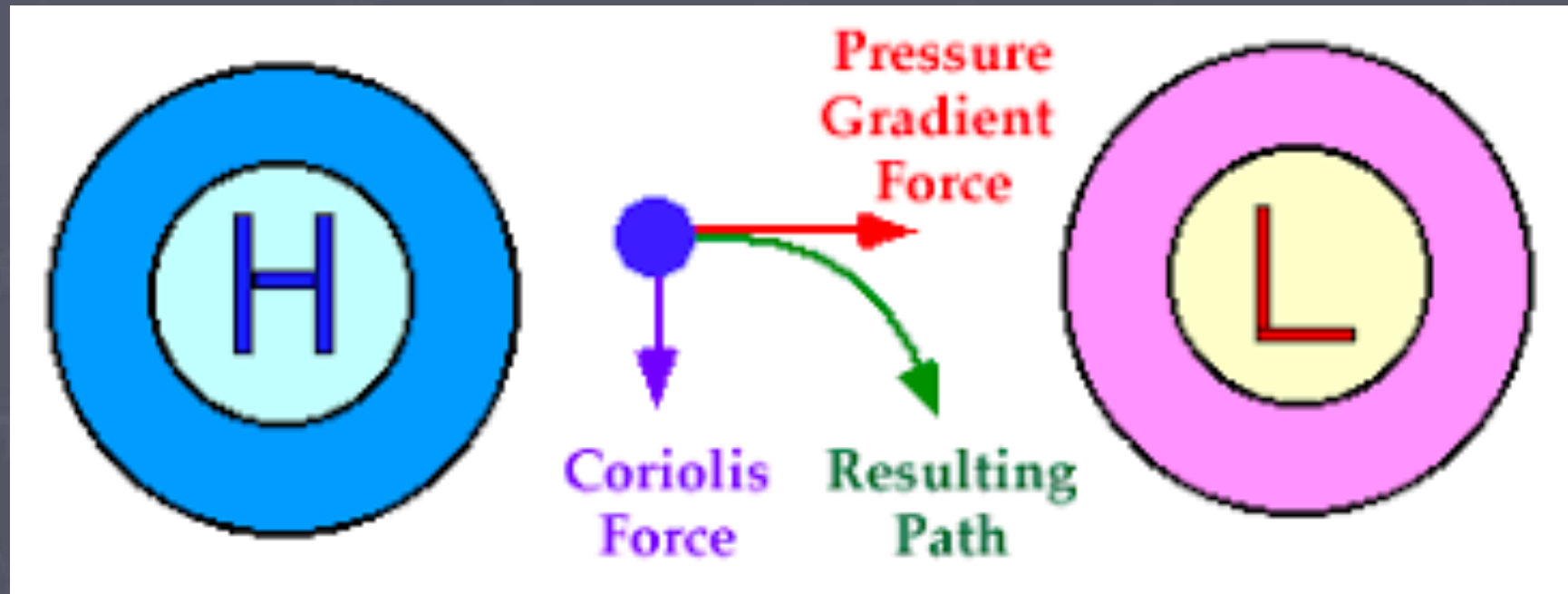




ff	Miles per hour
⊙	Calm
—	1-2
└	3-8
└└	9-14
└└└	15-20
└└└└	21-25
└└└└└	26-31
└└└└└└	32-37
└└└└└└└	38-43
└└└└└└└└	44-49
└└└└└└└└└	50-54
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└└└└└└└└└└└	61-66
└└└└└└└└└└└└	67-71
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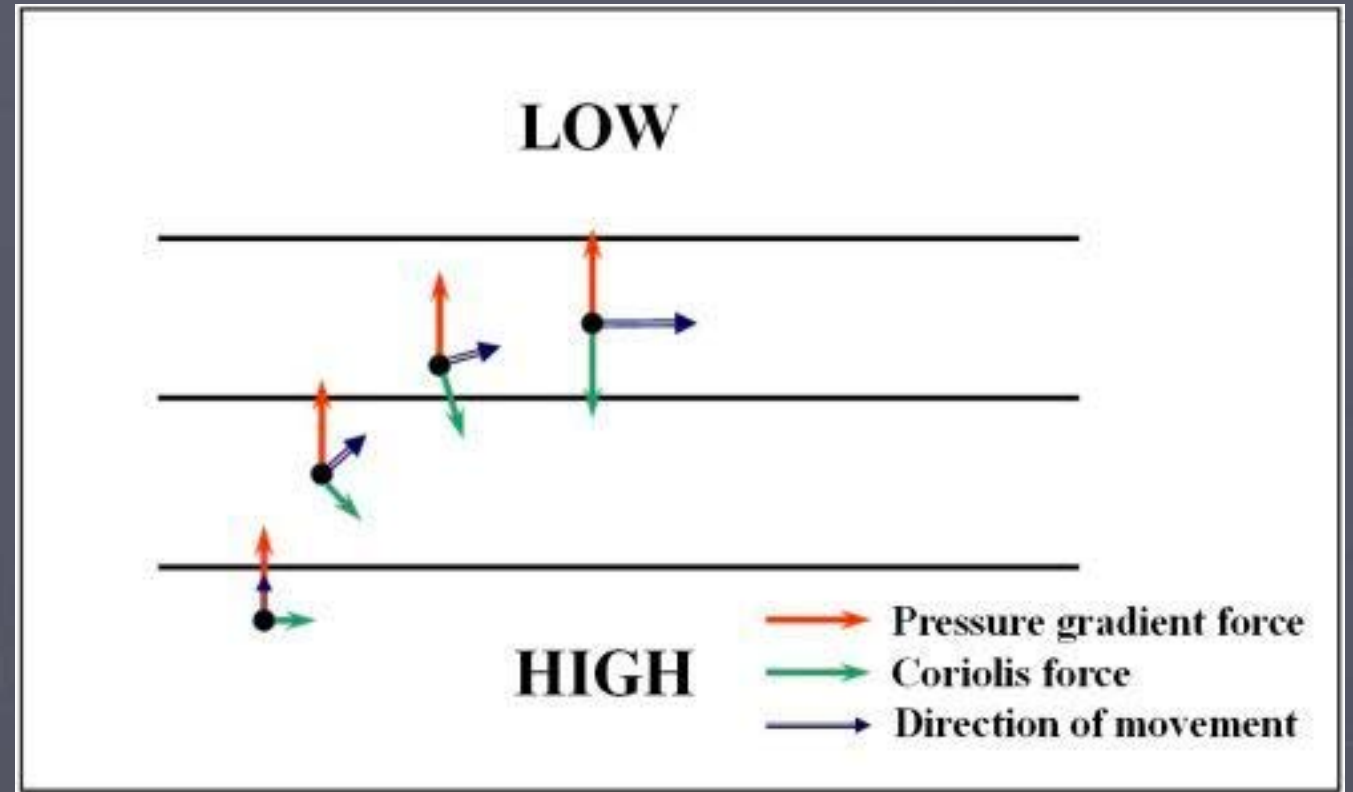
# Coriolis Effect

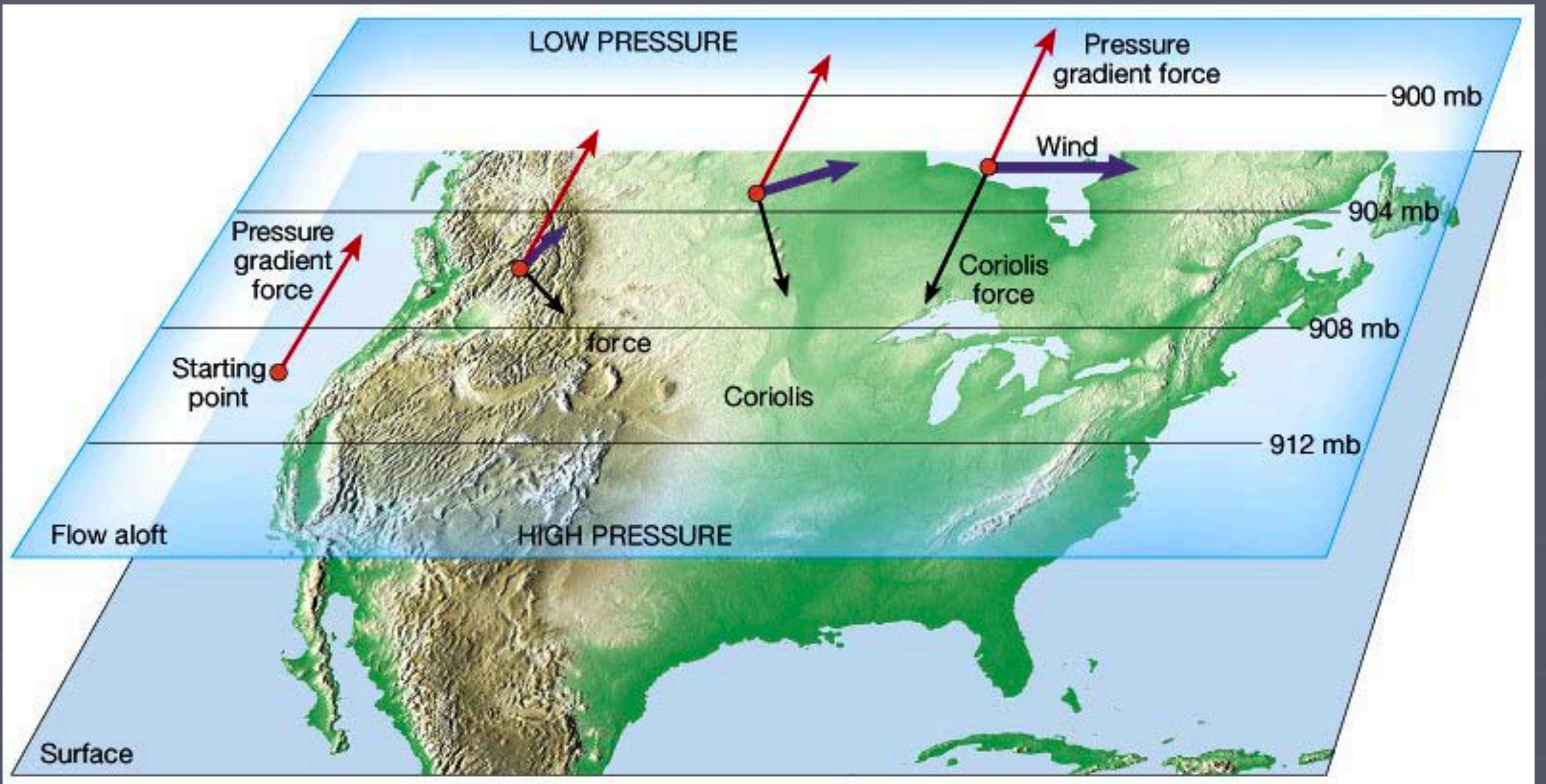
- Direction of Movement
  - Response to Earth's rotation
  - Deflects the movement of air from high to low pressure



# Impact of Coriolis Effect

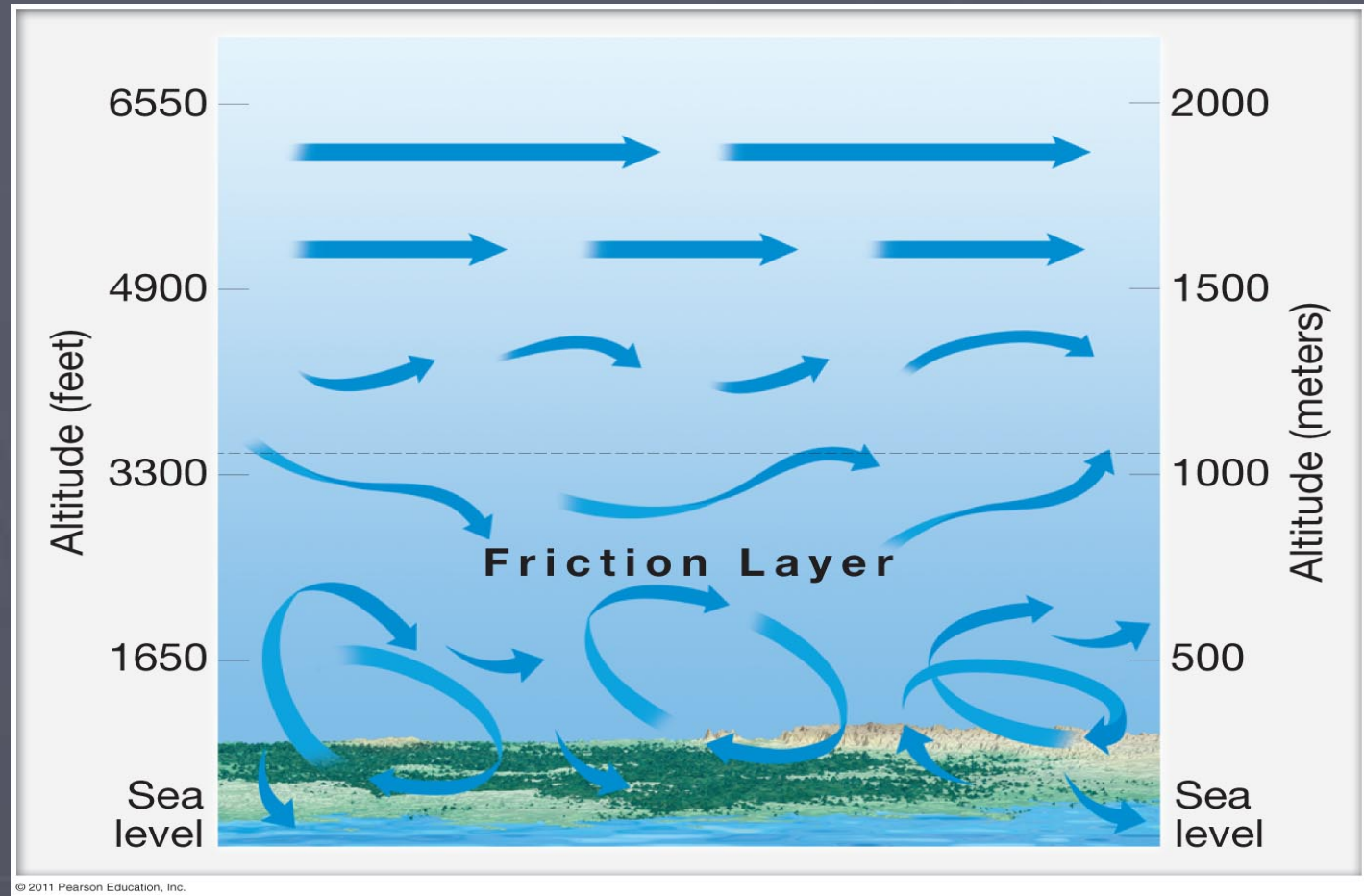
- Helps to cause winds to move in more of a spiral instead of straight-line
- Wind deflected to the right in Northern Hemisphere and left in Southern
- **Geostrophic Winds:** Above 1000m (without friction) winds can travel parallel to Barometric Gradients





# Friction

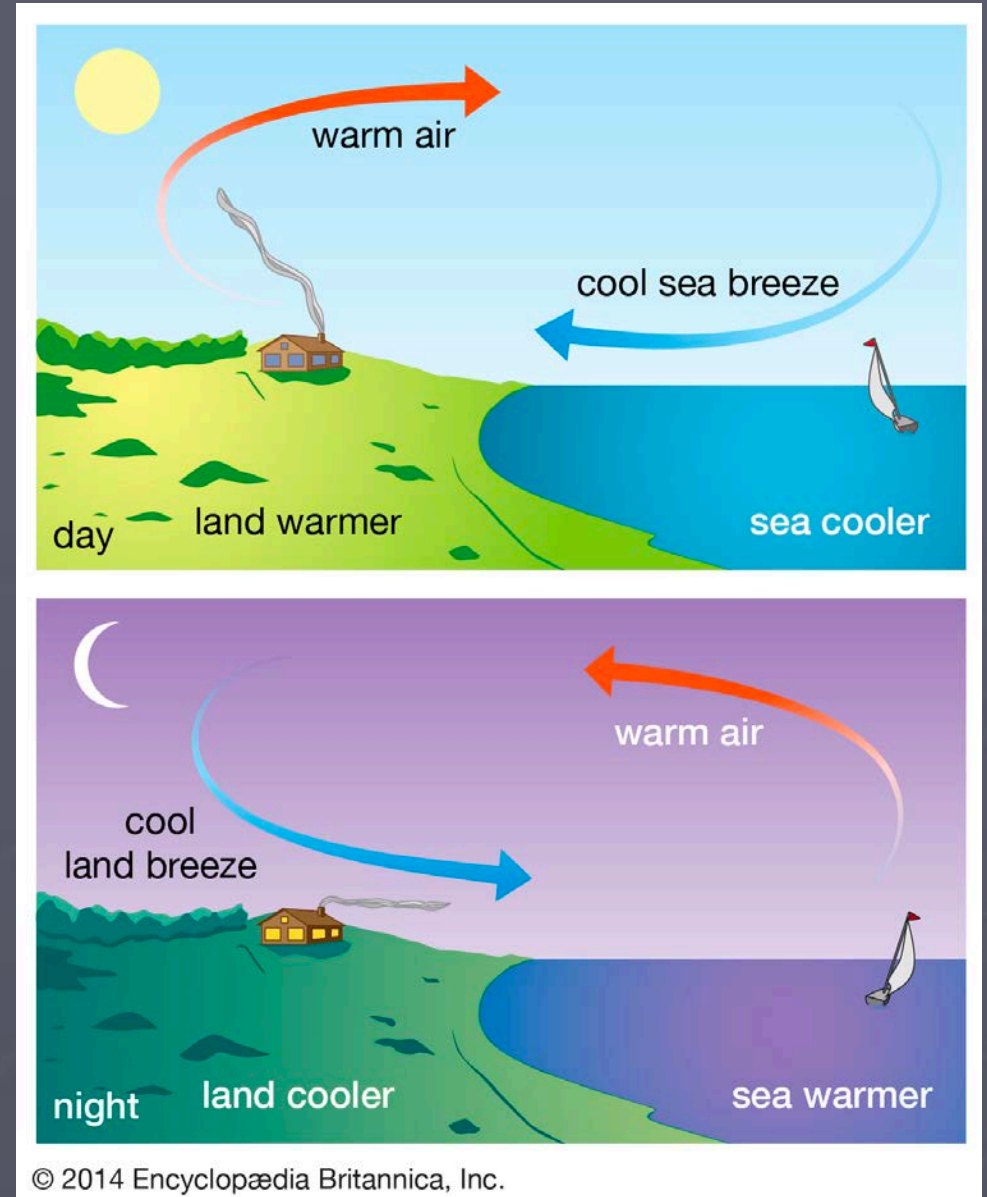
- Wind speeds slowed and even change direction at lower altitudes
  - Drag along earth's surface
  - Friction works opposite the direction of wind
  - Friction layer only a factor for about 1000m above the earth's surface





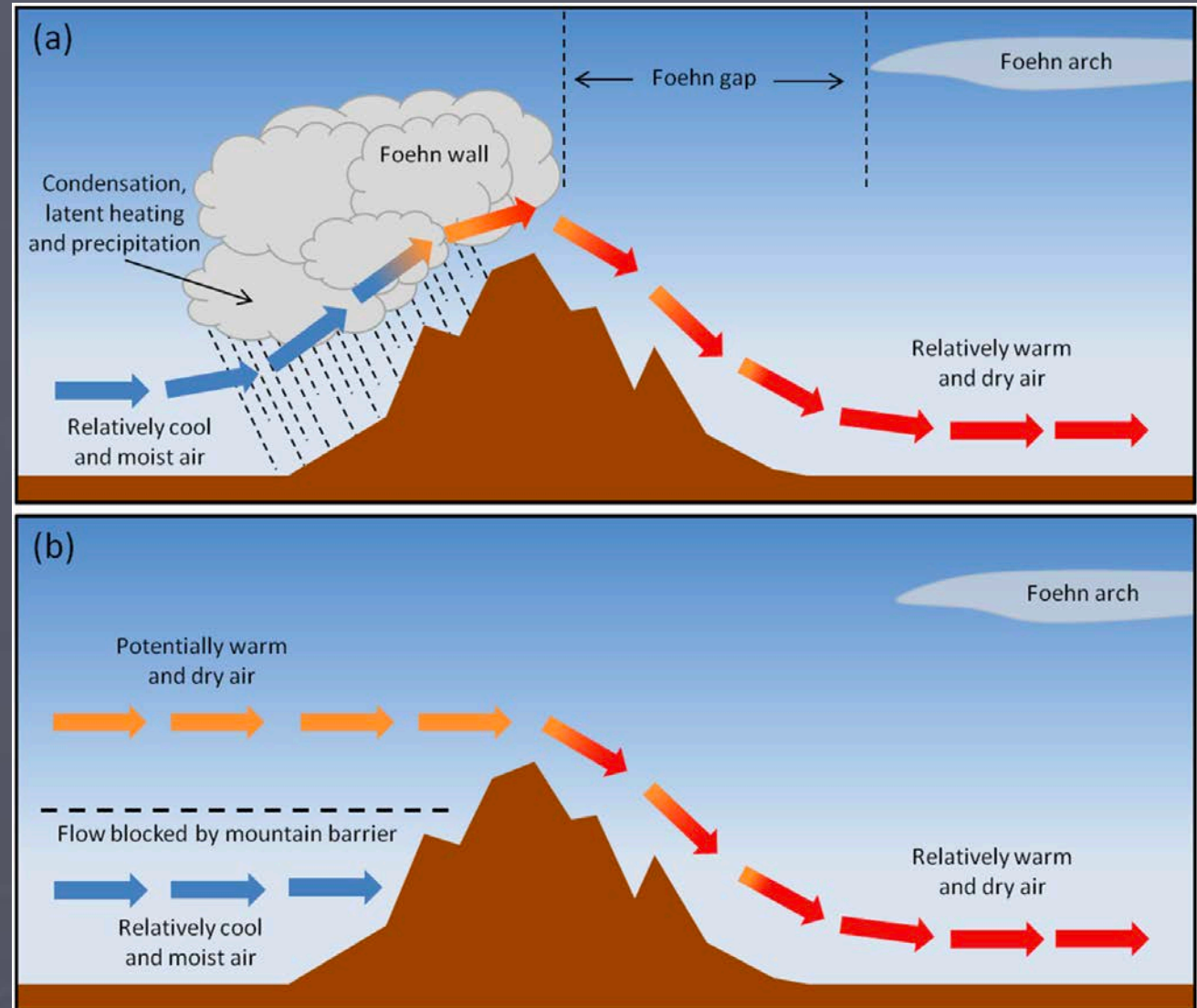
# Sea and Land Breezes

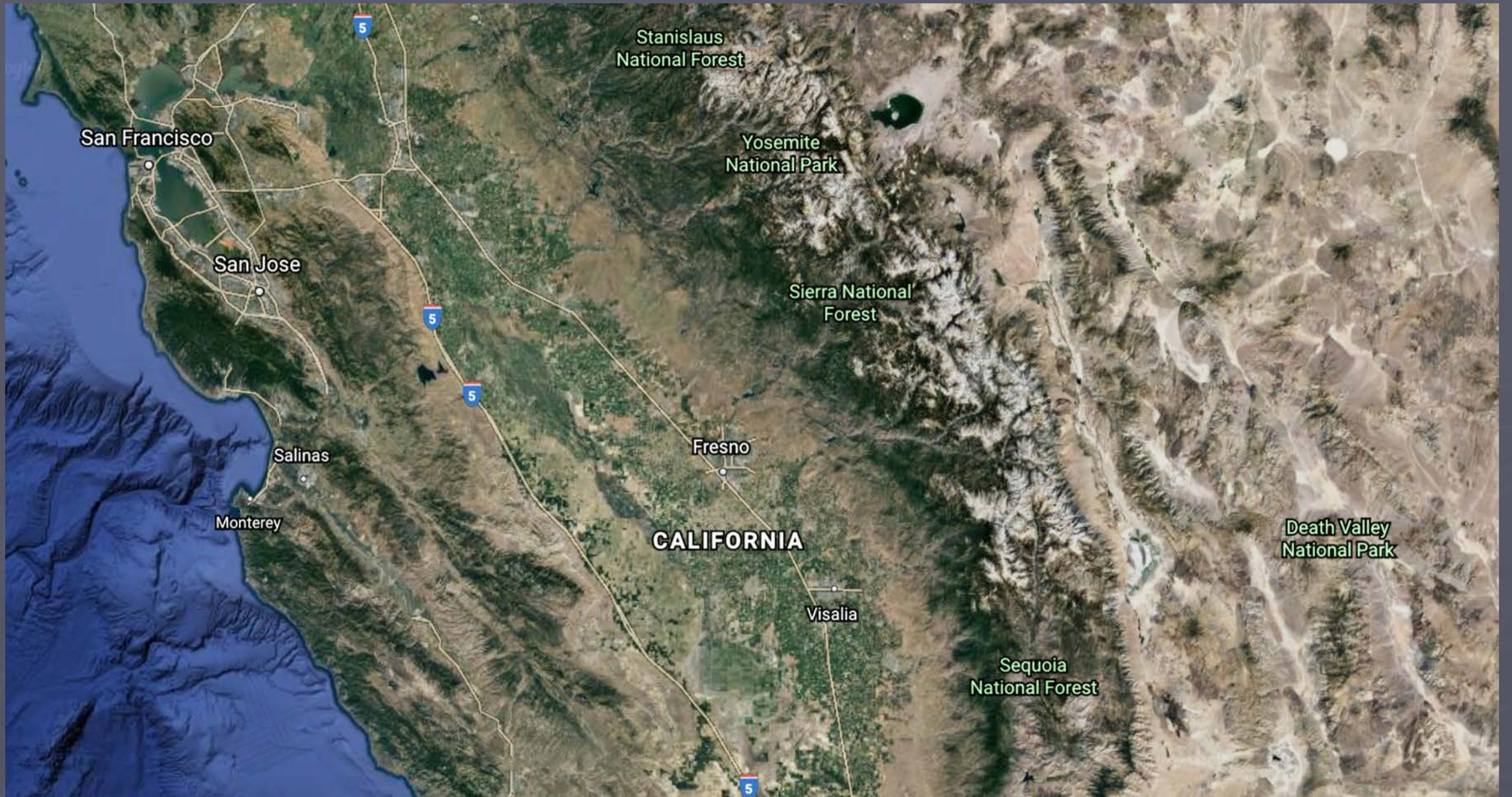
- Sea Breezes - when the land is significantly warmer than sea (usually summer or day)
- Land Breeze - when the land is significantly cooler than the sea (usually winter or night)



# Foehn/Chinook Winds

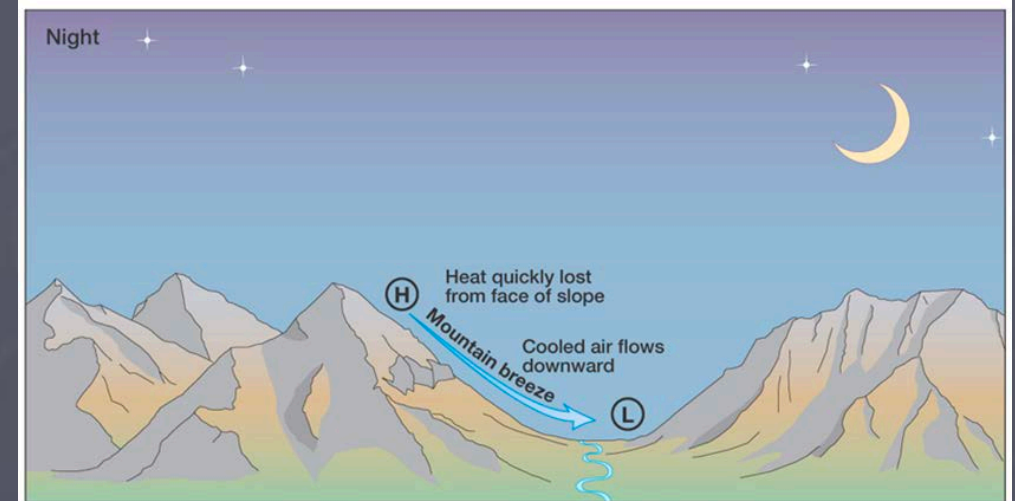
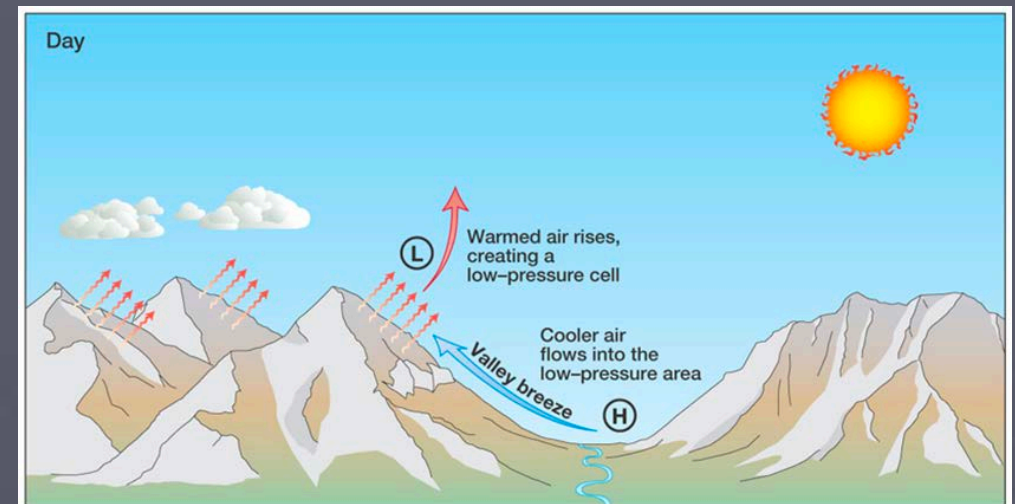
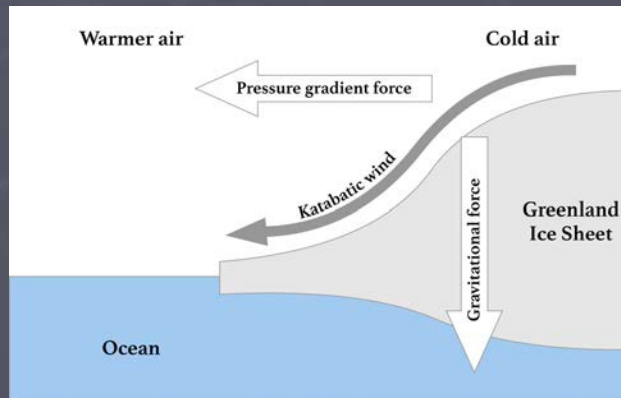
- Interaction between winds and mountains lead to differences between windward and leeward sides



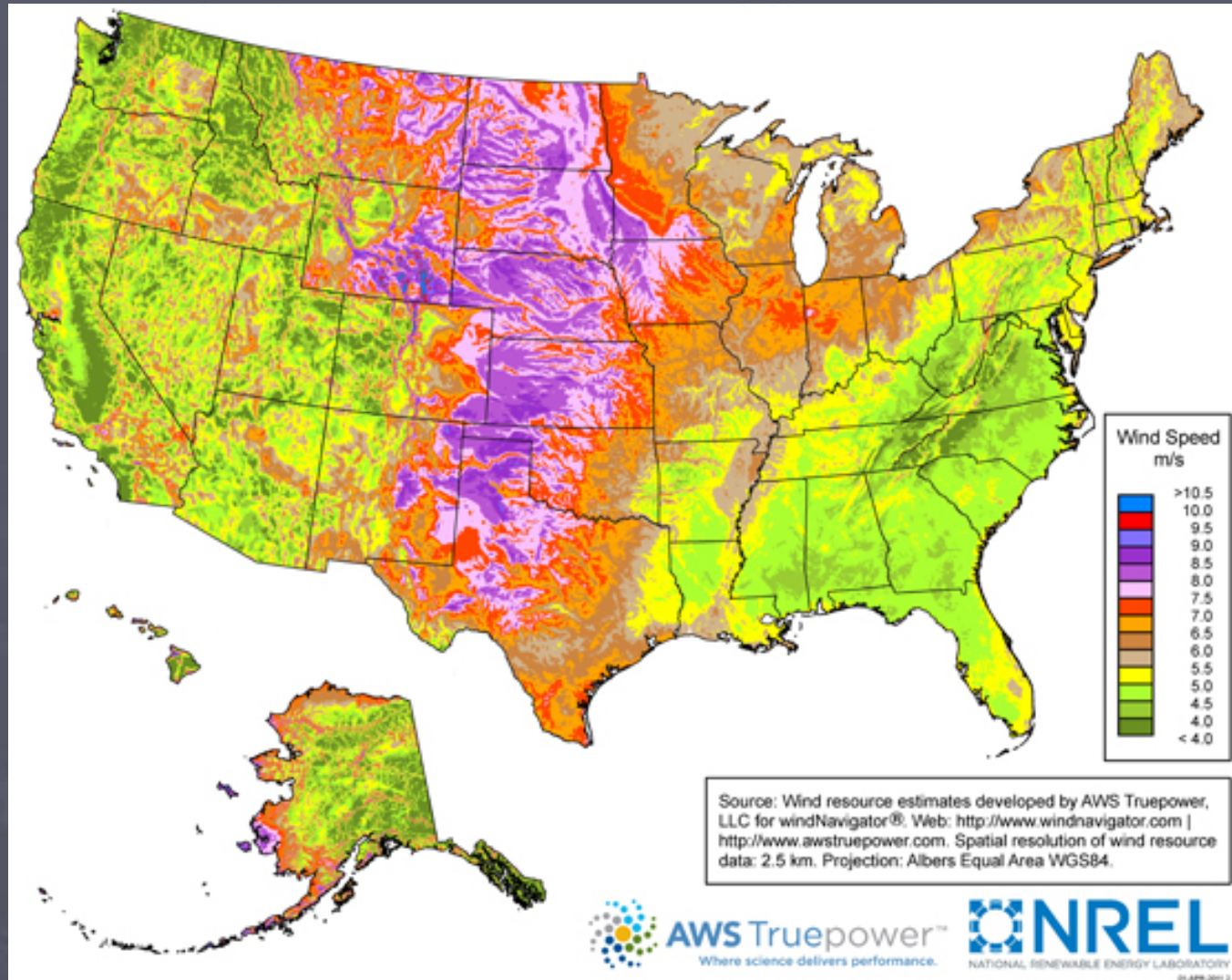


# Katabatic Winds and Valley Winds

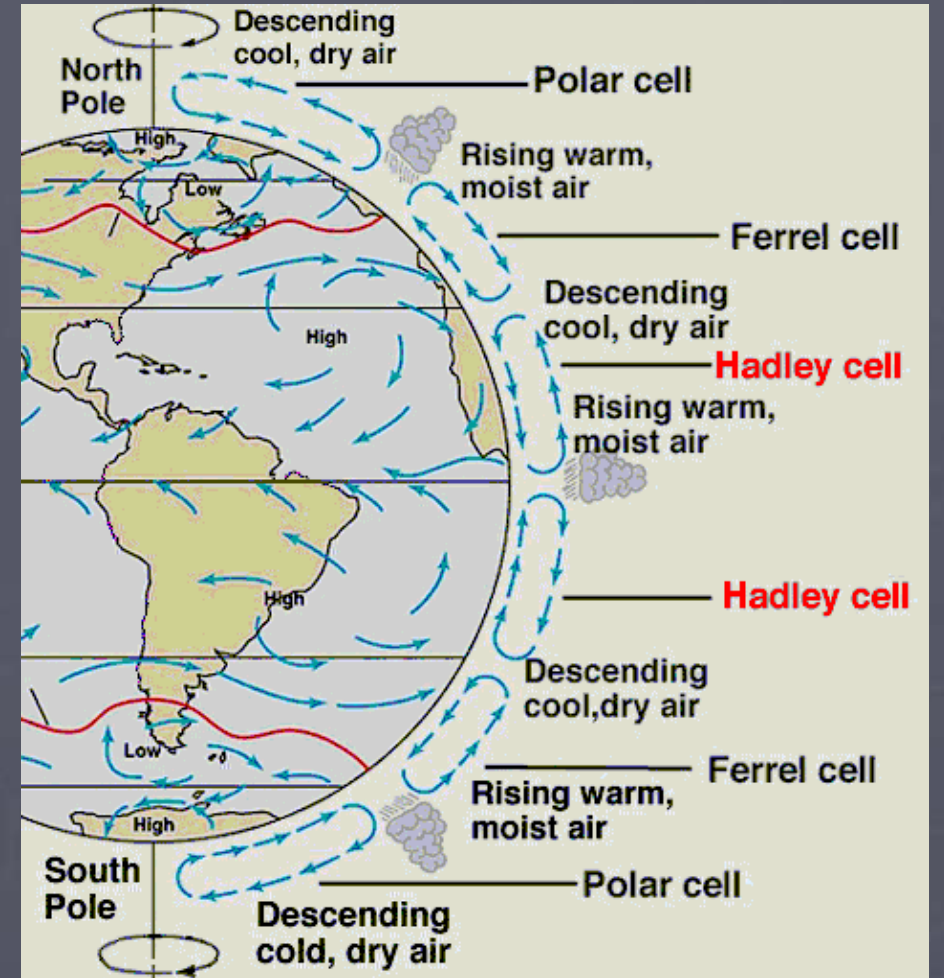
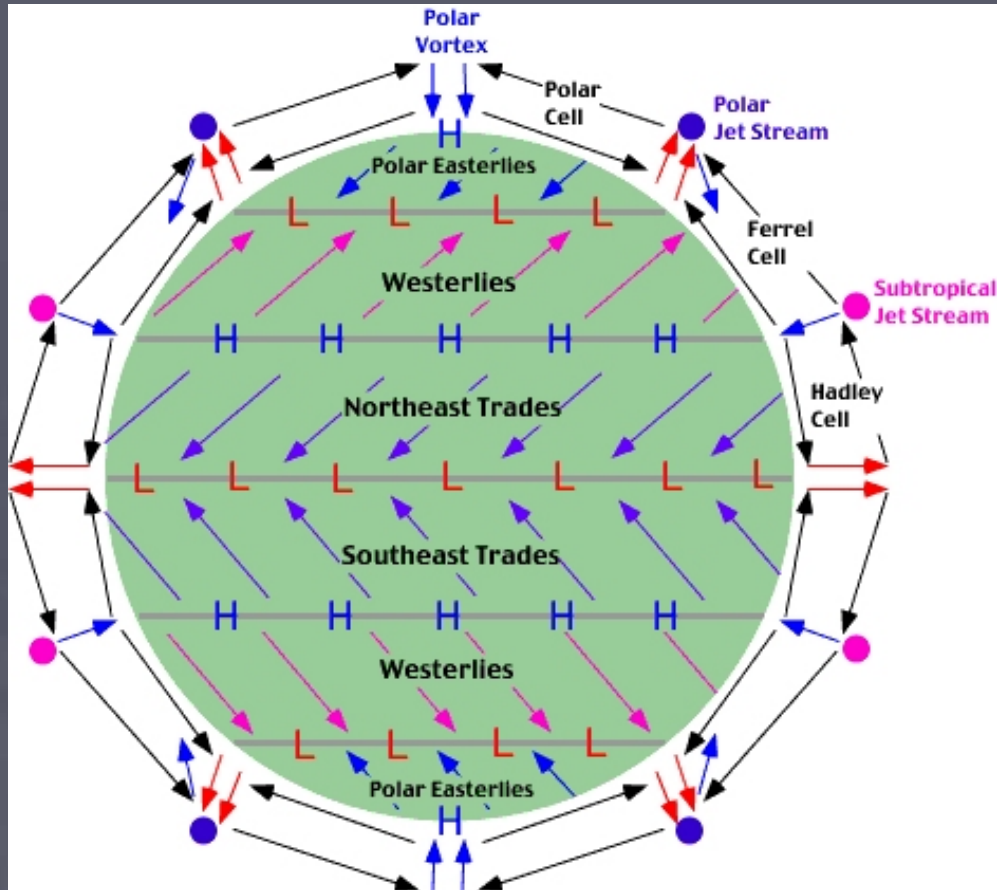
- Katabatic Winds – Winds that flow from cooler mountain tops to warmer lowland areas
  - Can also be from higher polar areas to lower warmer open seas
- Valley winds affected by daily patterns of warming and cooling



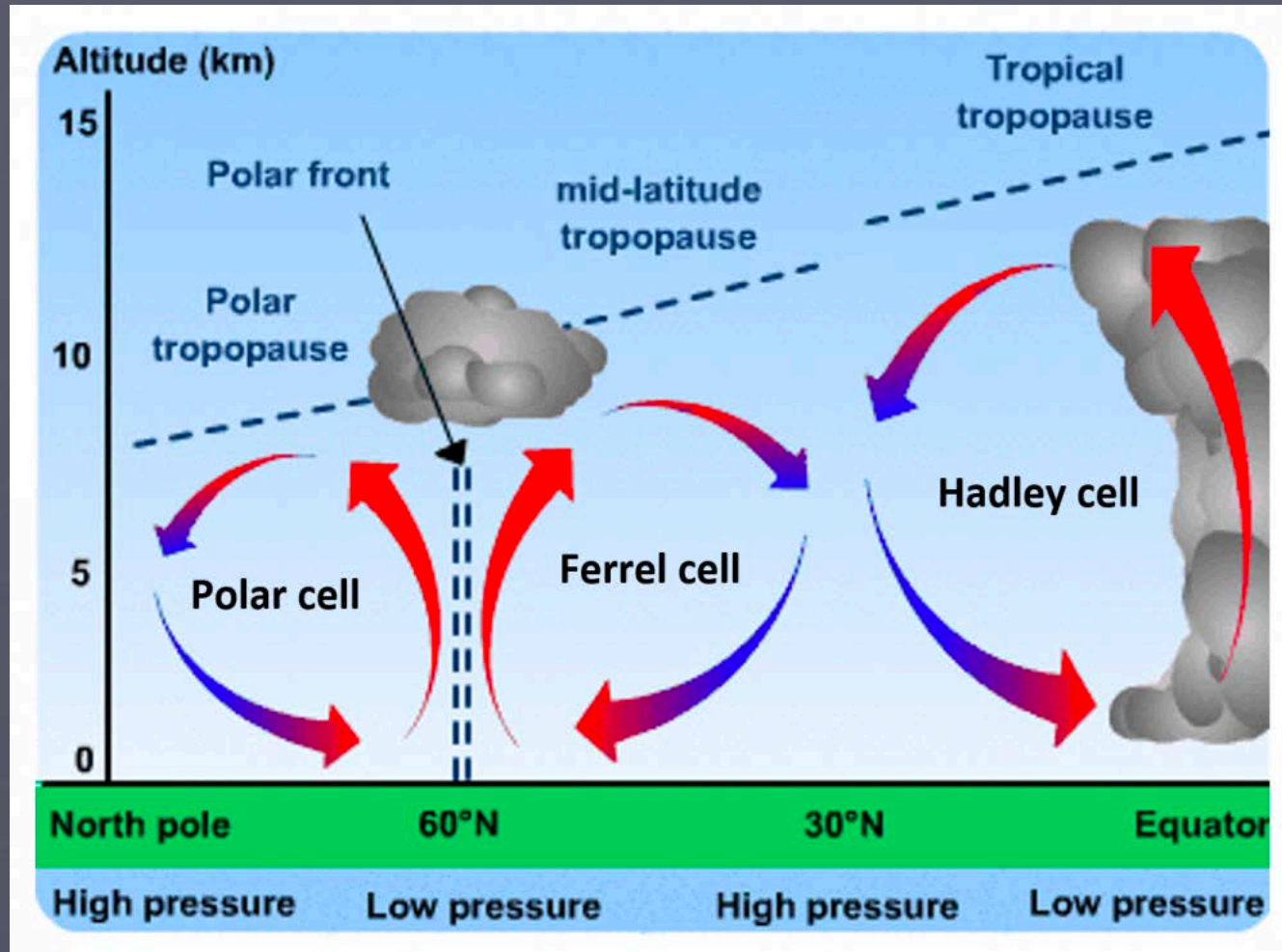
# Wind Speeds in the United States



# General Patterns of Air Movement

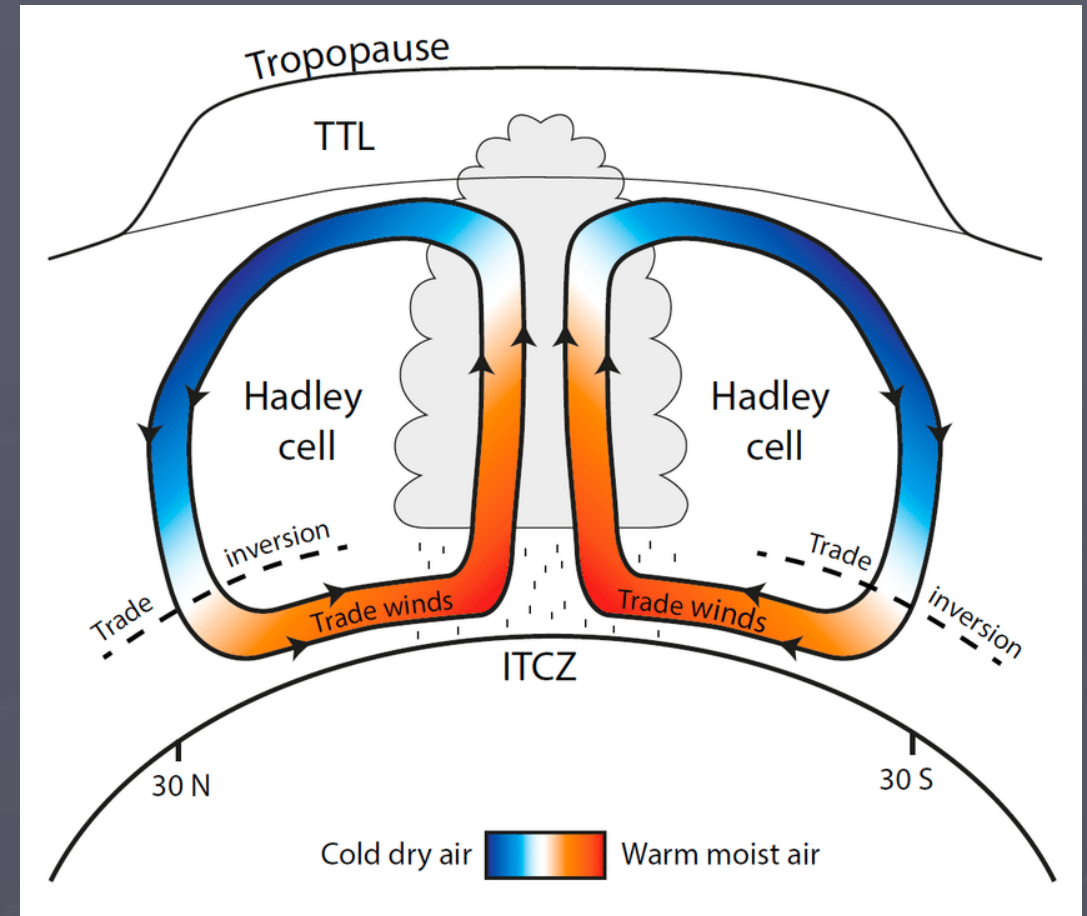


# General Patterns of Air Movement: Hadley Cells, Ferrel Cells, and Polar Cells



# General Patterns of Air Movement: Doldrums and Horse Latitudes

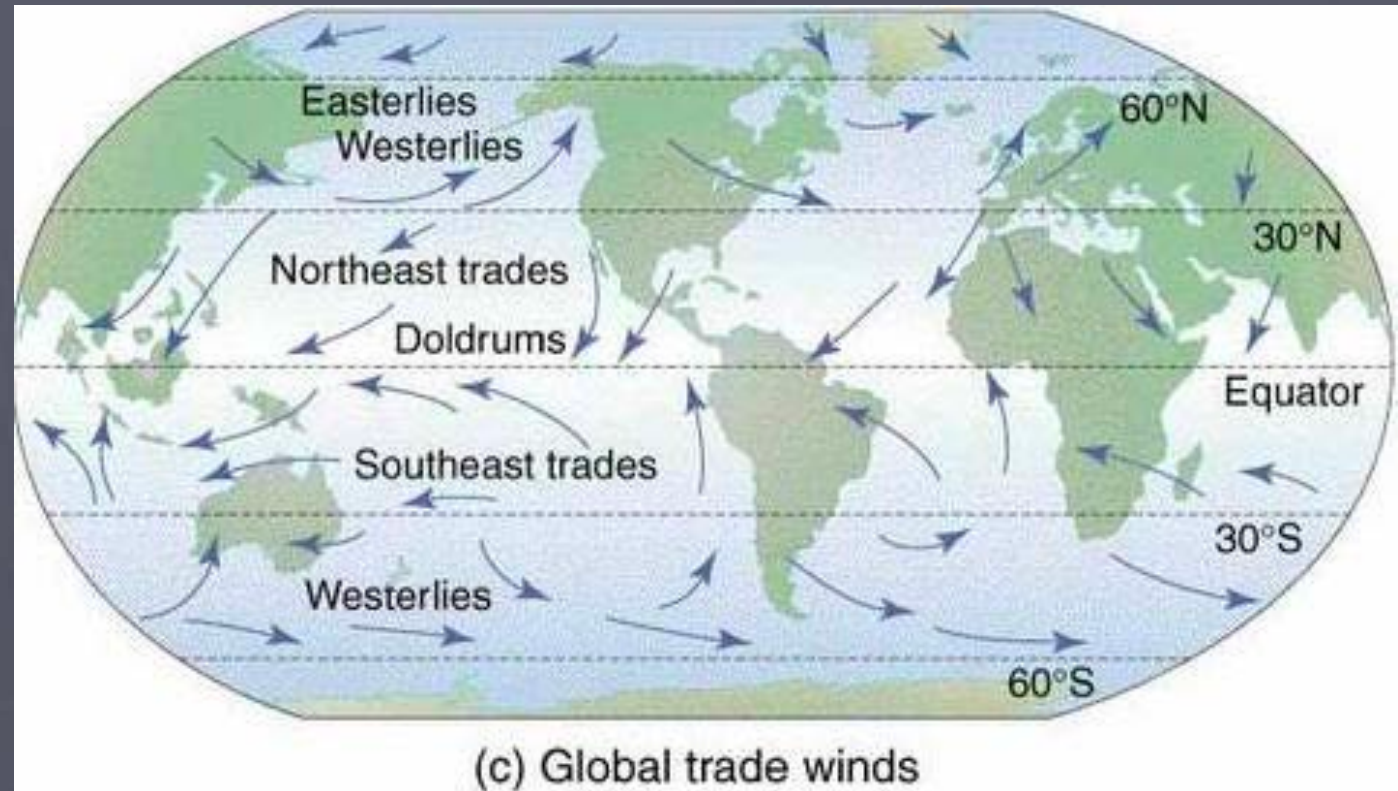
- Subtropical Highs (Horse Latitudes) (30 ° N and S) – Caused by simultaneous movements of Hadley Cells and Ferrel Cells
  - Associated with little moisture and little wind
- Intertropical Convergence Zone (ITCZ) Located near equator – Caused by movement of air up between two Hadley cells (aka Doldrums)
  - Characterized by lots of precipitation but little wind





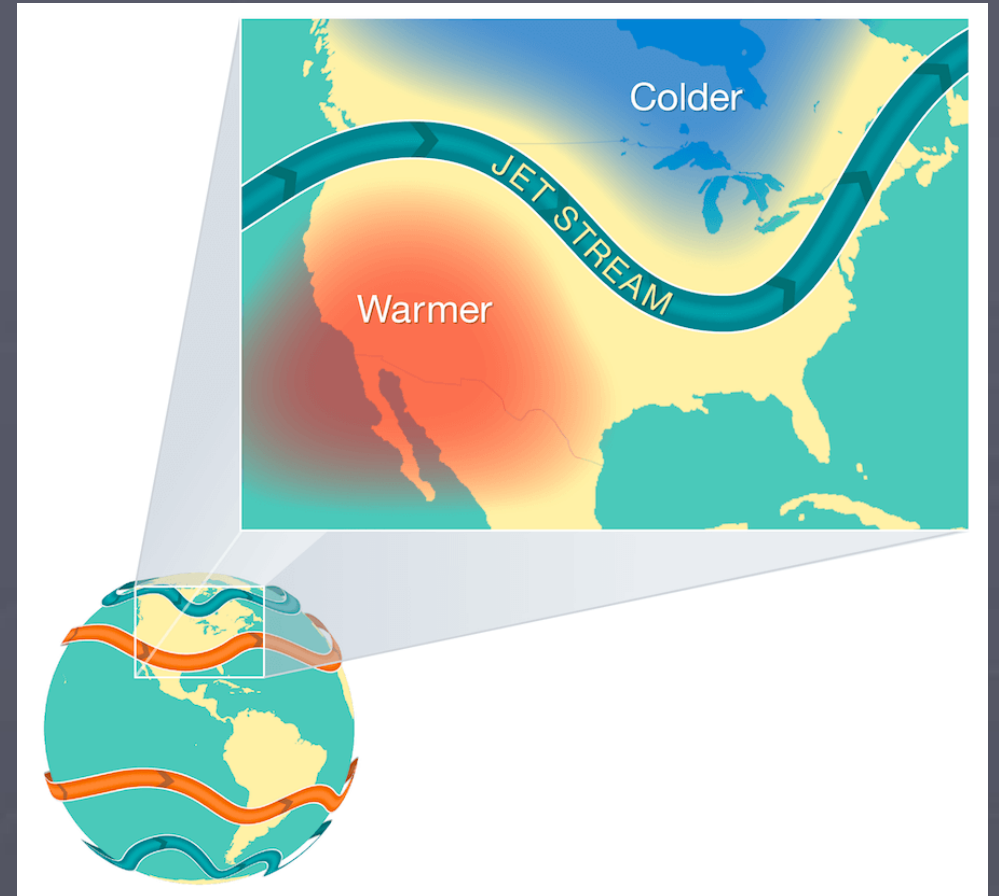
# Easterlies and Westerlies

- **Trade Winds** - As winds from Hadley and Ferrel cells work back towards areas of low pressure the Coriolis effect causes them to curve
- **Westerlies** – Winds moving from low pressure to low pressure away from poles again curving
- Winds named after the direction they come from



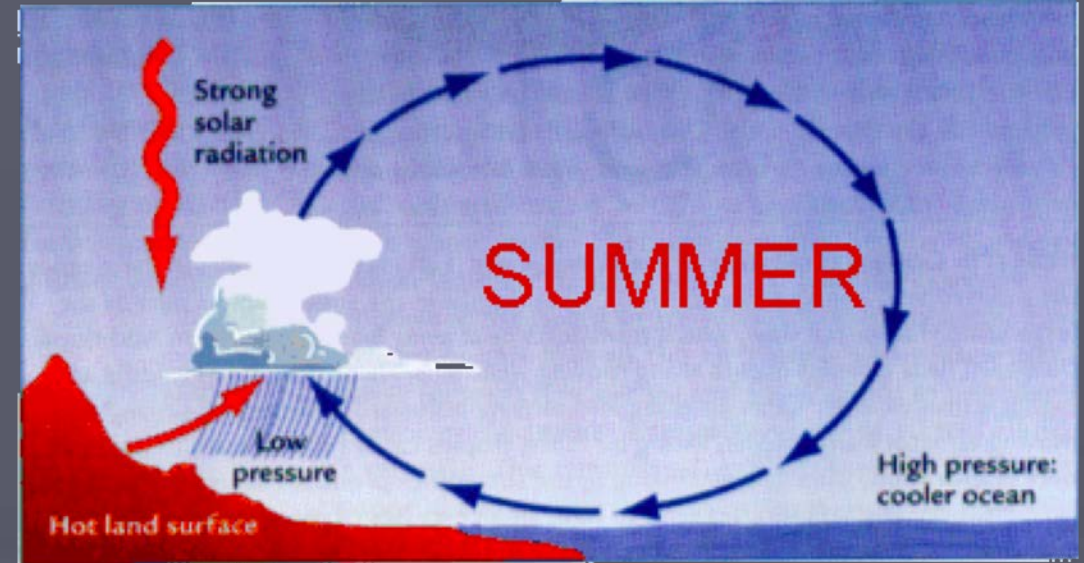
# Jet streams

- Two cores of high-speed winds at high altitudes
  - Form where warm and cold air masses meet in atmosphere
    - 5-9 miles high
    - High altitude and high speed (110 - 250mph)
  - Usually 2-3 per hemisphere
    - Polar front jet stream
    - Subtropical front jet stream



# Monsoons

- Summer causes heat difference over Indian Subcontinent
  - Shifts the ITCZ causing air filled with moisture to drop into India and Southeast Asia



# Rossby Waves

- Disruptions in the Polar Front
- Caused by the movement of warmer air northward
  - Causes undulations of polar air into lower latitudes

