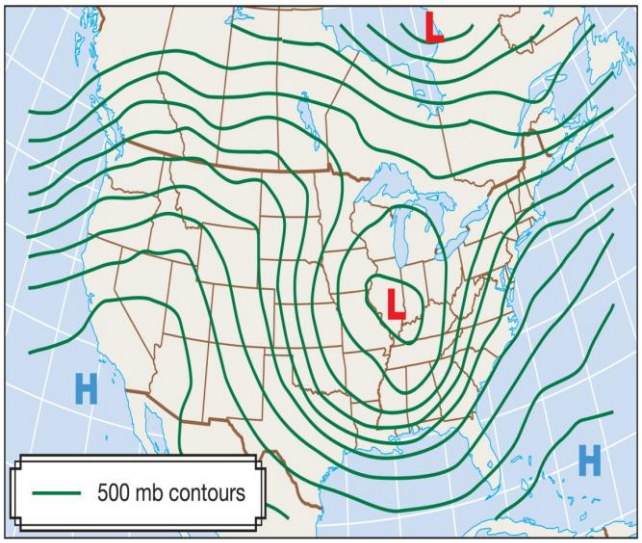
Chapter 4

Atmospheric Pressure and wind



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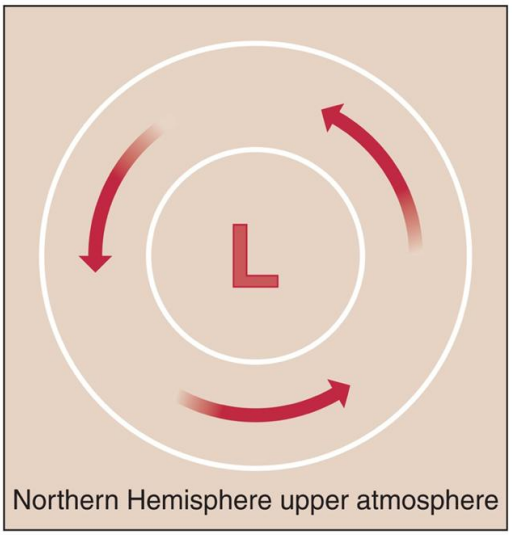
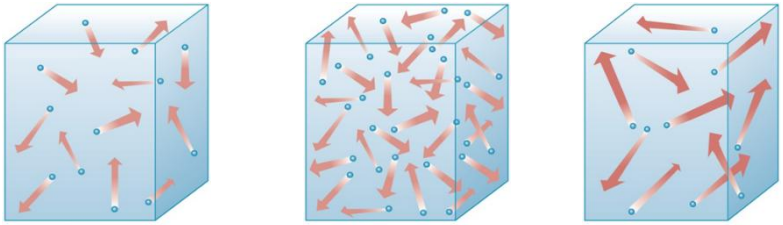


(b)

Chapter 4
Pressure and wind

Atmospheric Pressure
General Characteristics

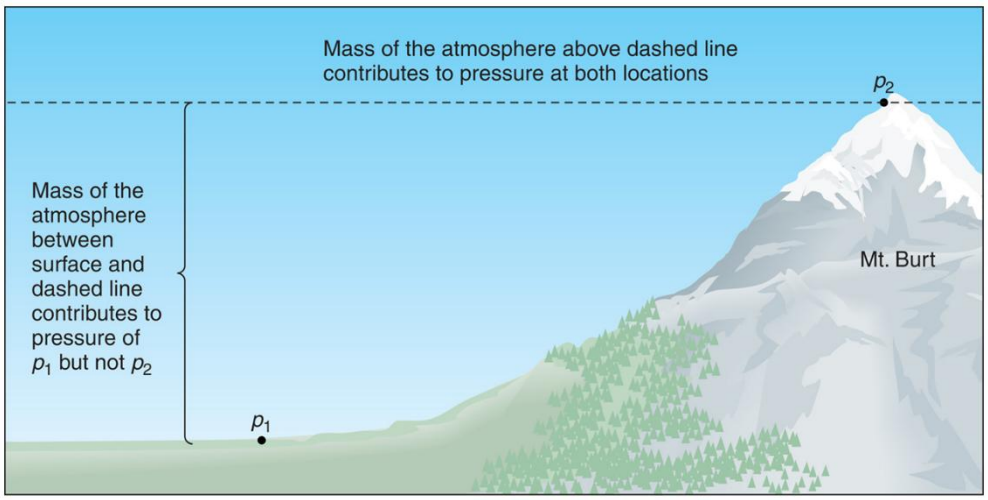
- Pressure is defined as force per unit area
- Pressure comes in different units:
  - Pascals(Pa), milibars(mb), inches of mercury (in Hg),
- pounds per square inch (psi)
- Pressure exists due to molecular collision



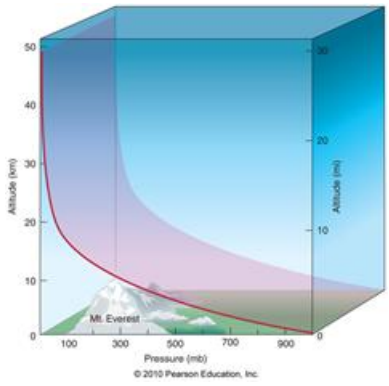
(1) (2)

Pressure increases with:
1) Higher density
2) Higher temperature

Pressure anywhere in the atmosphere is due to the weight of air above



- Pressure decreases faster near the surface, less so aloft (due to higher density near surface)
- Ultimately due to compressibility

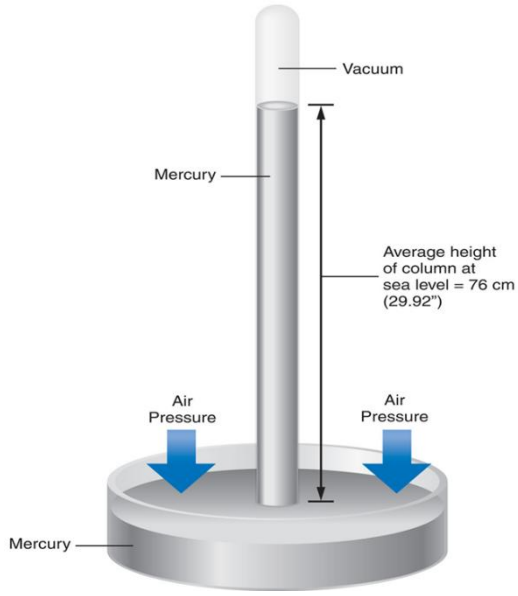


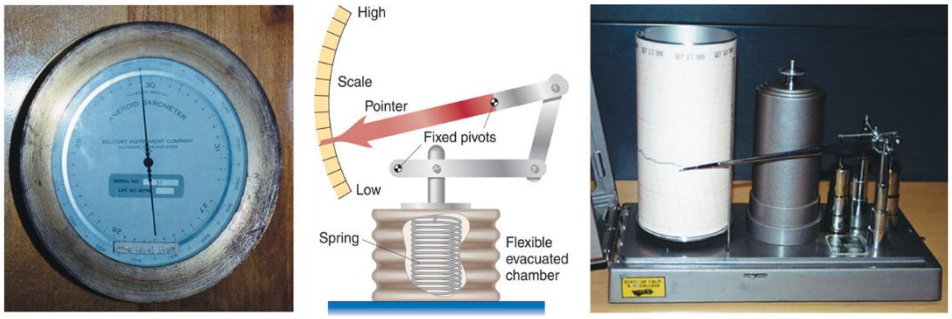
- The nature of atmospheric pressure explains much, including:
    1) My exploding bag of chips
    2) The gravity-defying upside-down cup of water (and the straw trick)

Measuring Pressure

Barometer – an instrument that measures pressure

1) Mercury barometer
2) Aneroid barometer



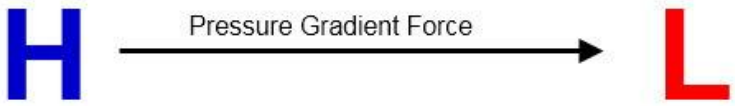


Horizontal Pressure Distribution

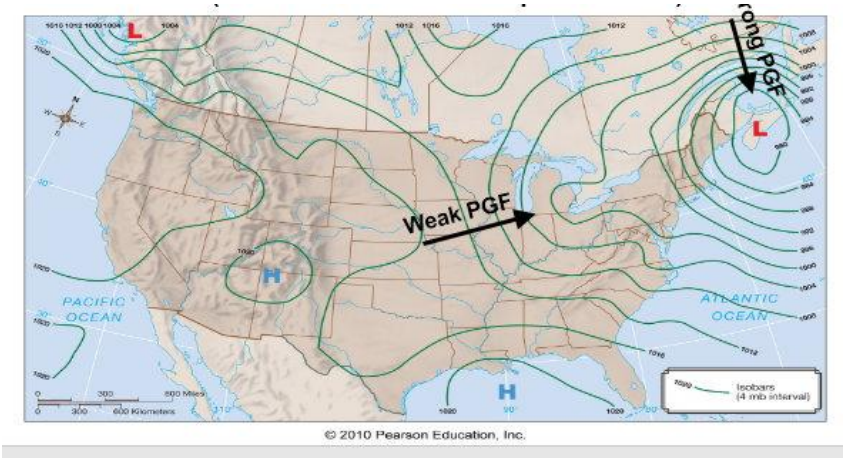
- Pressure gradients (change in pressure with distance) cause air to move
    ➔ Wind!!!
- This wind is a direct application of how force equals mass times acceleration (F=m*a)
- In the case of wind, the force (F) is the pressure gradient force

Pressure Gradient Force

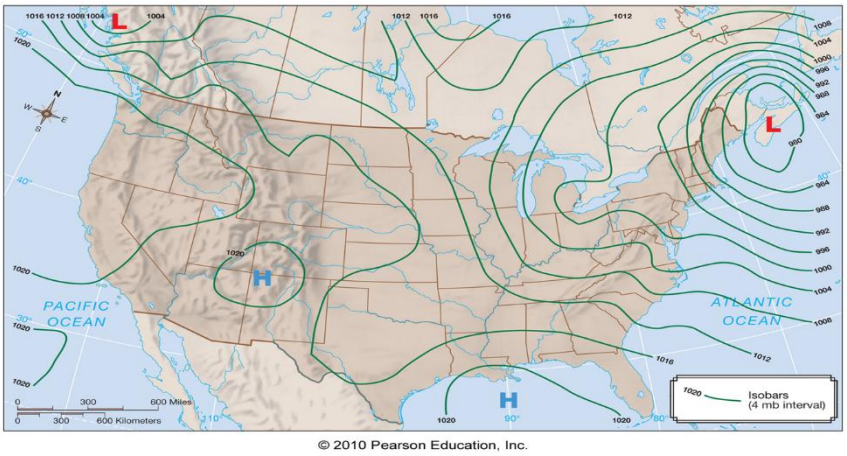
- The pressure gradient force always points from HIGH pressure toward LOW pressure!!!



- Pressure is viewed horizontally using **isobars** (lines of constant pressure)

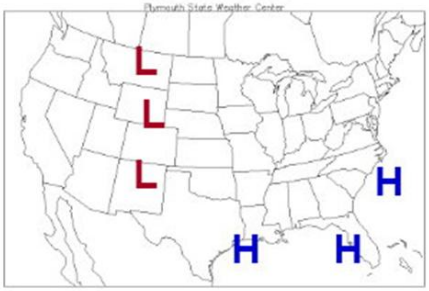


- Sea level pressure maps are a good weather analysis tool*, but wait a second…*



If Station Pressures Were Used

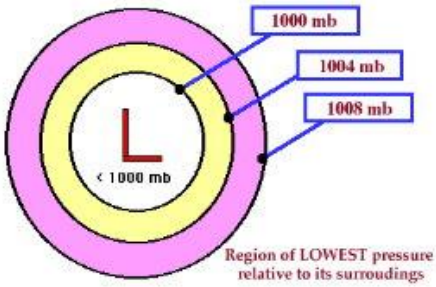
- Lower pressure in mountain areas
- Higher pressure in coastal areas
- Not a true picture of atmospheric effects



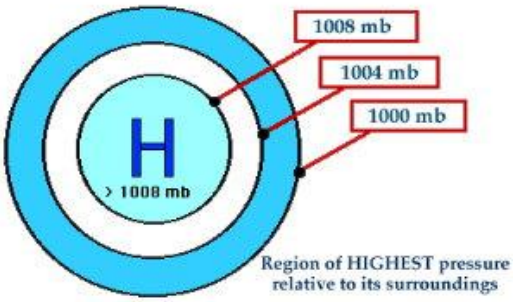
- Surface pressure observations are "reduced" to sea level (10 mb/100 meters is typical in lower atmosphere)
- These sea level pressure values are the numbers on sea level pressure maps

- The effects of elevation are removed, revealing a more useful horizontal pressure distribution

Lows and Highs



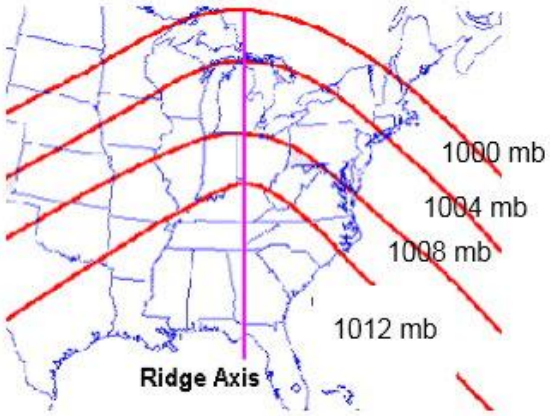
Cyclone



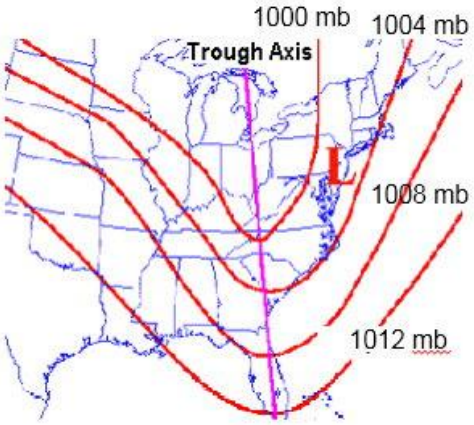
Anticyclone

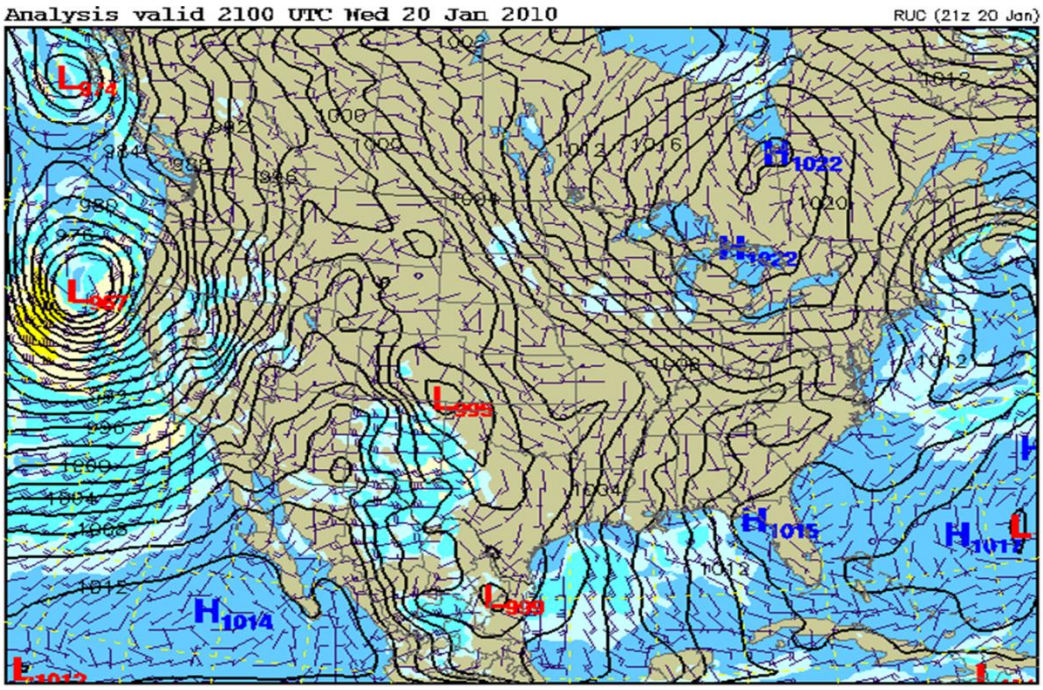
Ridges and Troughs

Ridge – a bow in isobars indicating a line of high pressure



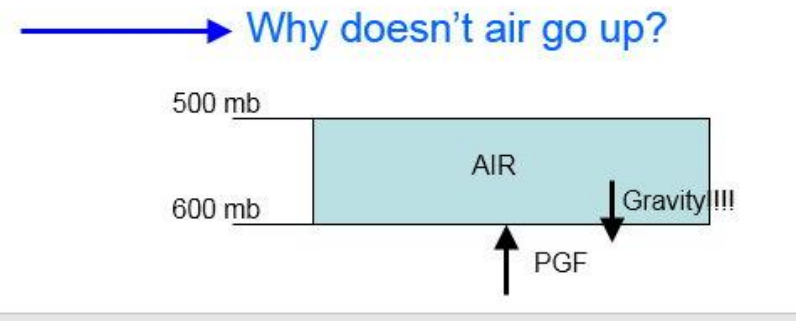
Trough – a bow in isobars indicating a line of low pressure





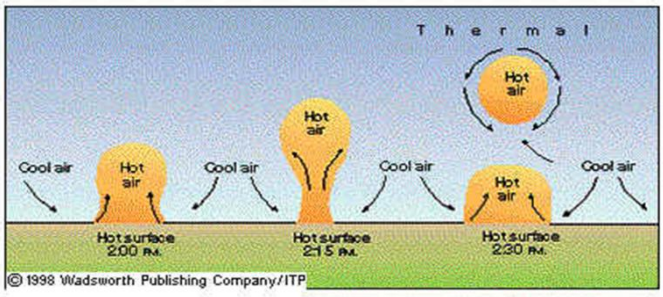
Vertical Pressure Distribution

- Pressure always decreases with height
  - Fastest near the surface
  - Vertical pressure gradients many times greater than horizontal pressure gradients



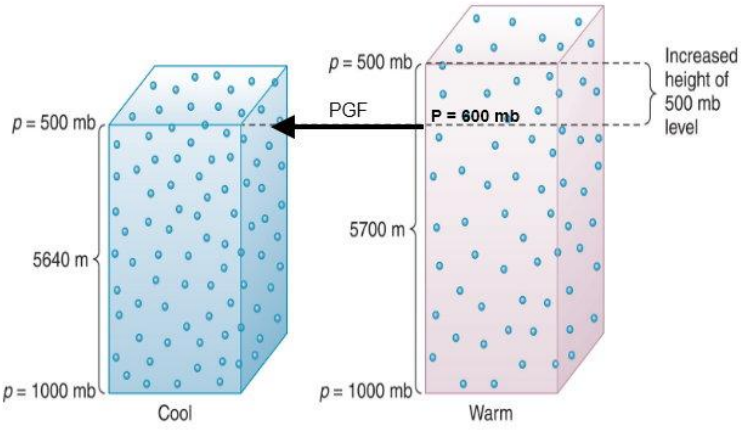
Hydrostatic Balance

- Hydrostatic balance (or equilibrium) is the balance between the pressure gradient and gravity forces in the vertical
  - Exists almost always in the atmosphere
  - Exception is convection and thunderstorms

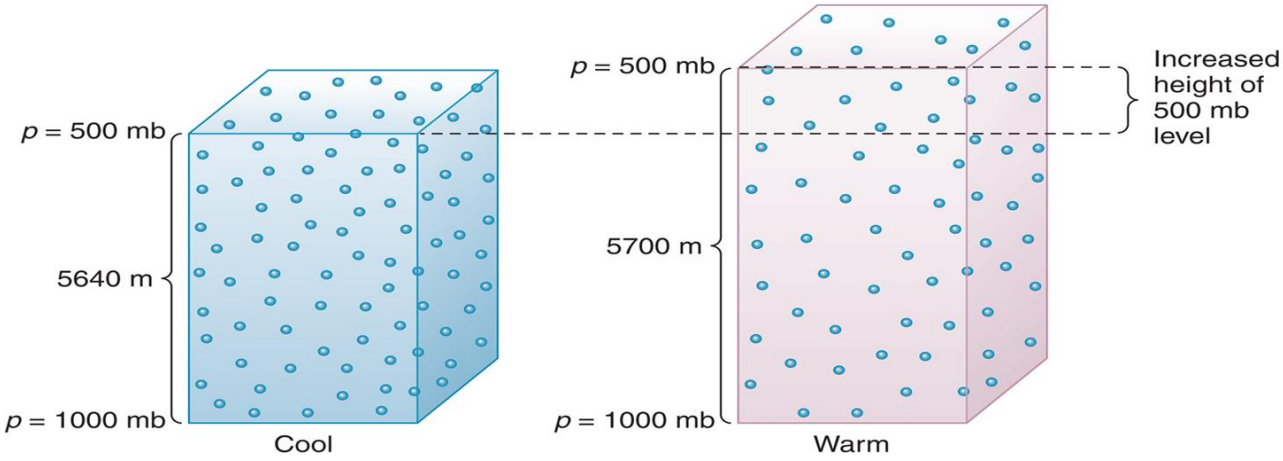


Horizontal Pressure Maps Aloft

- The height of a pressure level depends on temperature



- Stronger temperature difference = stronger pressure gradients
- Higher heights mean higher pressure



The 500 mb Map

- Closer lines = larger slopes = stronger PGF
- Higher heights to the south (warmer)
- Ridges and troughs (Important – they make the weather!)
- Lines of constant height = isohypse (isoheight)