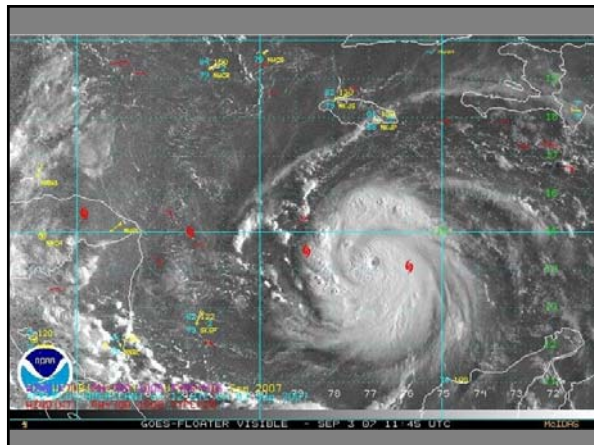


MET 4532 Hurricanes

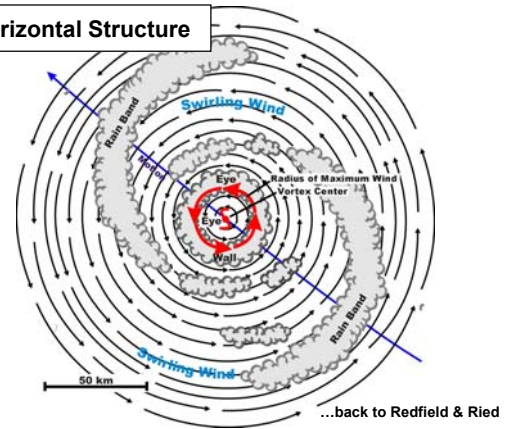
Lecture 4
Hurricane Structure
28AUG17

Assignment:

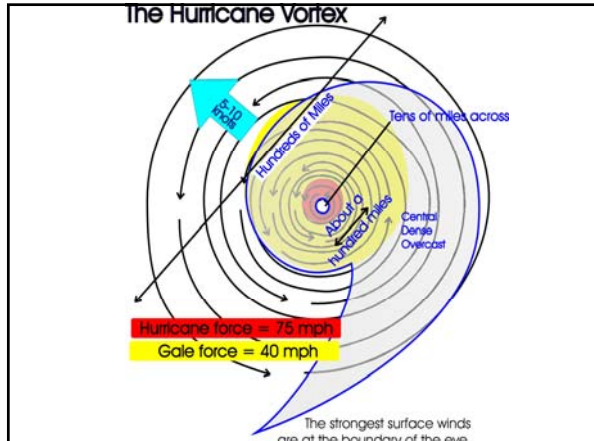
- **For Next Time:**
- SW, 31-60: 19th Century
- E, 68-71: Samoa Cyclone
- E, 82: Herndon and the *Central America* 1857.



Horizontal Structure



The Hurricane Vortex



WINDS OF THE HURRICANE

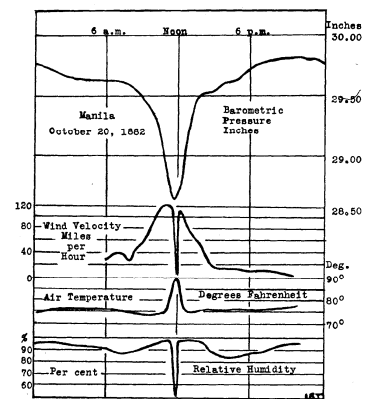


FIGURE 10. Barometric pressure, wind velocity, temperature and relative humidity during passage of typhoon over Manila on October 20, 1882.

Physical Laws

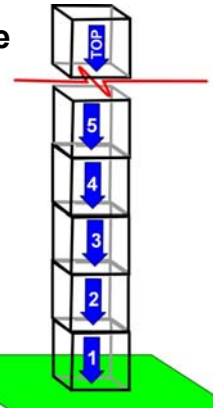
- **Hydrostatic law:** Pressure is the weight of the air above.
- **Gas law:** Warm air is less dense than cold
- **Gradient Balance:** Low pressure draws air into a (counterclockwise) circular path around the center of a cyclone.

Hydrostatic Pressure

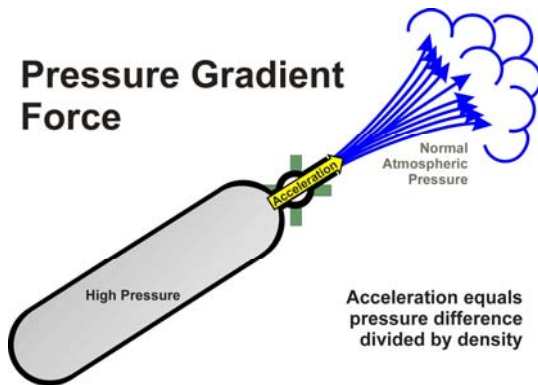
Difference between pressure at top and bottom of a layer is the total weight of the air in the layer.

A cubic meter of air weighs about 1.2 kg at the surface, so the barometric pressure on a square meter of ground is just the sum of the weights of all those cubic meters between the surface and outer space.

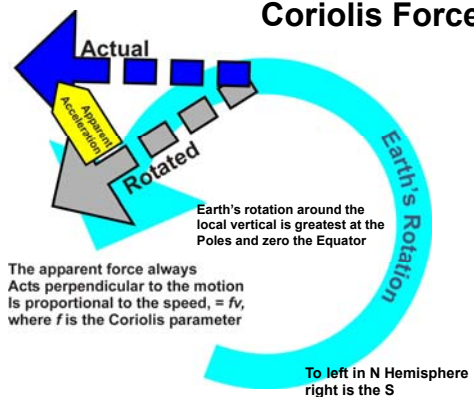
Because the temperature inside hurricanes is warmer, the air is less dense and the pressure is lower than normal by as much as 10%.



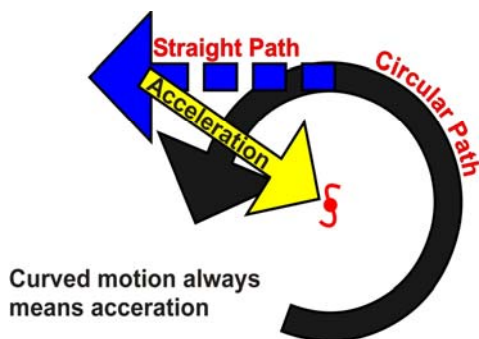
Pressure Gradient Force



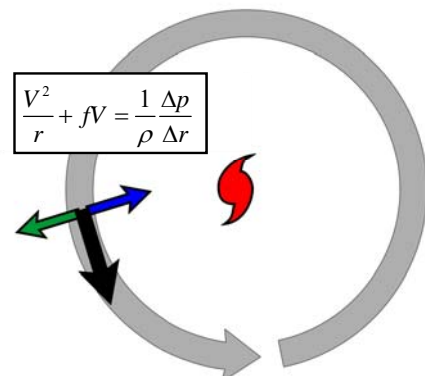
Coriolis Force

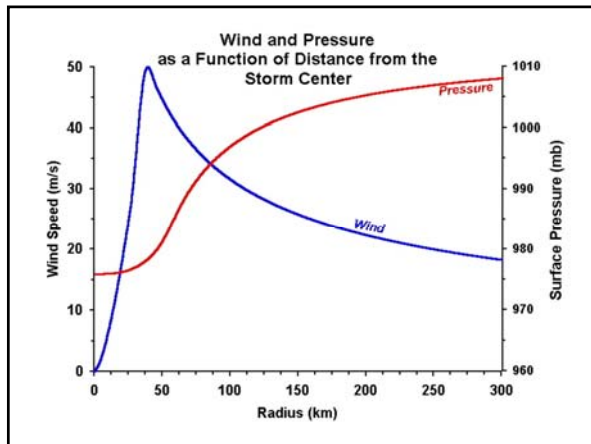


Centripetal Acceleration



Gradient Balance





Pressure-Wind Relation

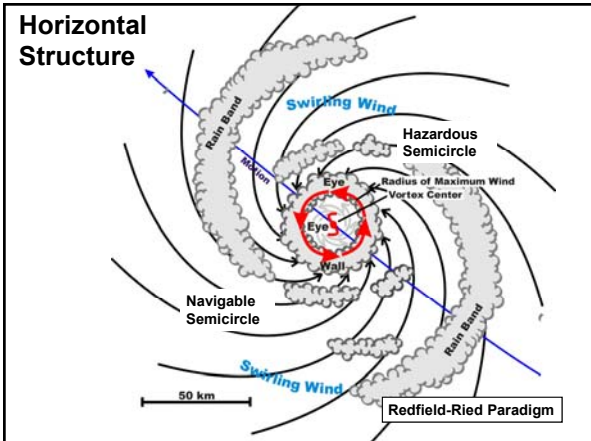
$$V_{\max} (\text{kt}) = 15\sqrt{1013 - p_{\text{cent}}}$$

or

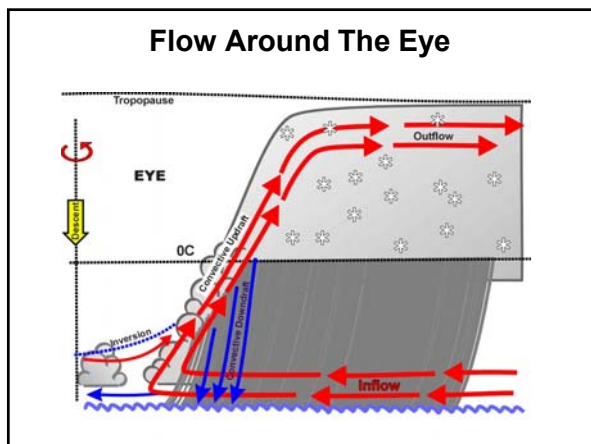
$$V_{\max} (\text{m s}^{-1}) = 7.5\sqrt{1013 - p_{\text{cent}}}$$

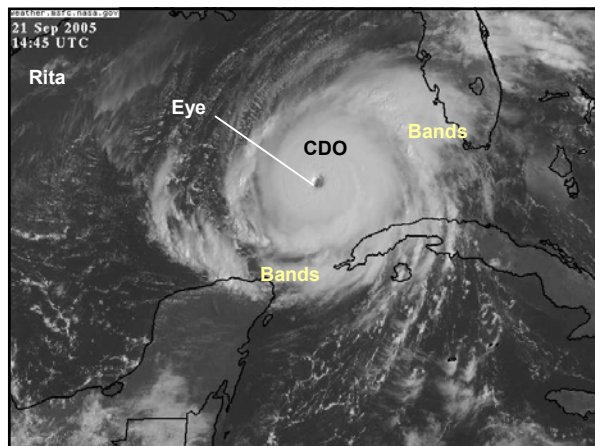
Where V_{\max} is the strongest wind anywhere in the hurricane (in kt or m s^{-1}) and p_{cent} is the surface pressure at the center in millibars. Not particularly accurate

Hurricanes get their energy from the warm surface waters of the tropical sea.



Flow Around The Eye





Summary

- Circular, long-lived vortex that moves more slowly than its circulating wind (RR Paradigm)
- Warm, low-hydrostatic-pressure center
- Circulating wind in gradient balance with pressure distribution
- Wind increases from calm at the center to a maximum at the edge of the clear eye, and then decreases with distance from the center outside the eye
- Secondary circulation
 - Frictional inflow
 - Buoyant, outward sloping eyewall updraft
 - Precipitation-driven downdraft
 - Upper tropospheric outflow
 - Outer anticyclone
 - Clear eye filled with subsiding air.

Assignment:

- **For NEXT TIME**
- SW, 31-60: 19th Century
- E, 68-71: Samoa Cyclone
- E, 82: Herndon and the *Central America* 1857.

See You Next Time