

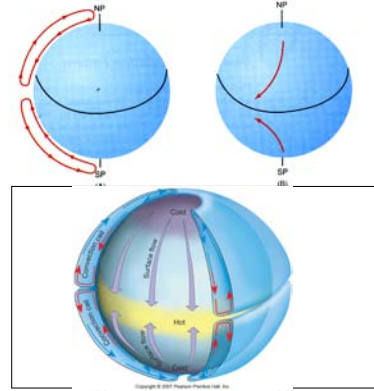
Coastal Meteorology

- Winds - Global
- Storm Systems
- Winds - Local
- Thunderstorms
- Tropical Storms
- Climate Change



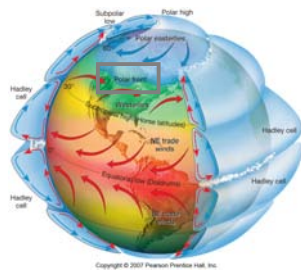
Global Winds

- Now, in this theory each hemisphere would have one wind blowing to the west
- In fact, each hemisphere has 3 wind bands

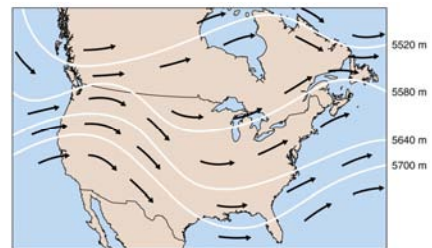


Three Global Wind Bands

In the U.S., winds generally blow from west to east (the Westerlies)

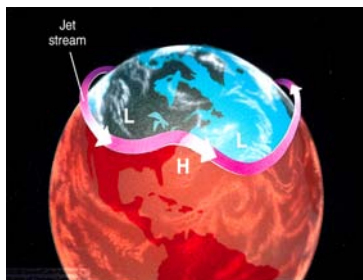


Westerlies



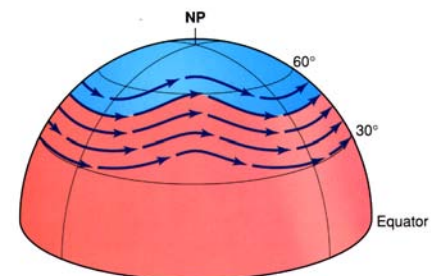
Jet Stream

- Polar Jet Stream over the Polar Front
- Many storms form at the Polar Front and are carried eastward by the Jet Stream
- Position migrates with the seasons.



Zonal Winds

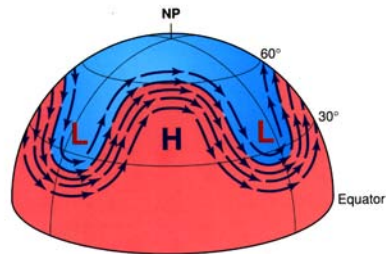
- Typical Summer pattern



Meridional Winds

- Large amplitude waves often in winter

Jet Stream



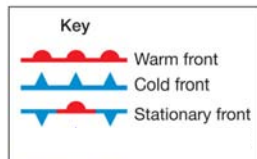
Storms

- Storms form in the Westerlies and are carried eastward across the U.S.
- All storms are Low Pressure systems
- Structure & characteristics of most storms are similar
- Changes in weather occur as **fronts**, (which develop in the storm) pass by a region



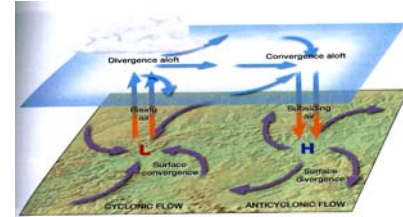
Fronts

- Boundaries between air masses
- **Stationary** - front not moving
- **Warm** - warm air displaces cold air
- **Cold** - cold air displaces warm air

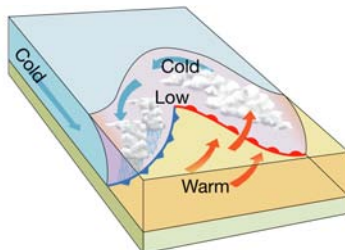


High and Low Pressure

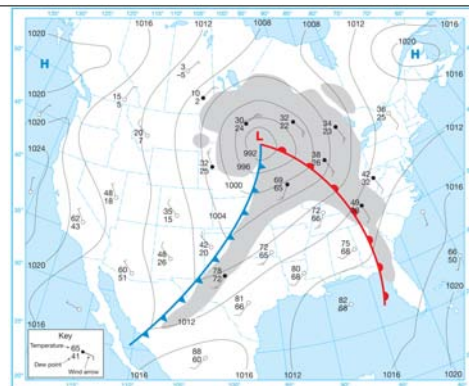
- Divergence Aloft - Air Rises - L Pressure (Cyclone)
- Rising Air cools - Clouds - Storms
- Due to Coriolis - CCW flow around a L



Formation of a Storm: Fronts



(c) Cyclonic circulation established

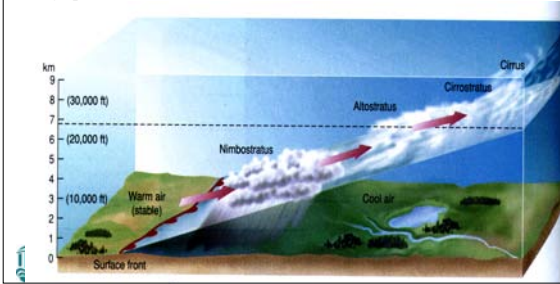


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Warm Front

Frontal Weather

- Warm air advances
- Average slope 200:1
- Avg speed 25-35 km/hr



Ahead of warm front:

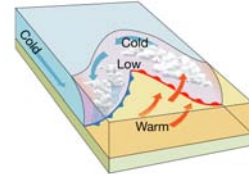
- Winds out of E, SE
- Cloudy - first high clouds, then thickening mid-level clouds, then low clouds

At warm front:

- Long lasting (~24 hrs) precipitation

Behind warm front:

- Winds out of W
- Clear
- Warm

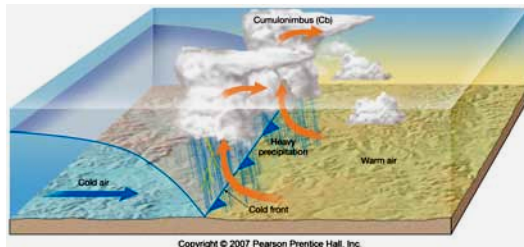


(c) Cyclonic circulation established



Cold Front

Average speed = 35-50 km/hr



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Frontal Weather

Ahead of cold front:

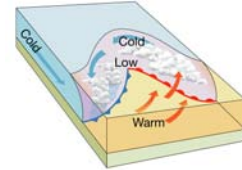
- Winds out of W
- Clear
- Warm

At cold front:

- Windy, stormy. Precipitation is brief (~ few hours)

Behind cold front:

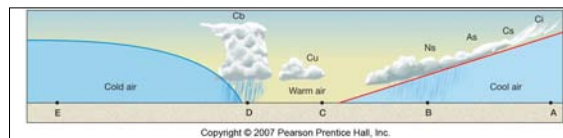
- Winds out of W, NW
- Clear
- Cold



(c) Cyclonic circulation established



Cyclone Tracks



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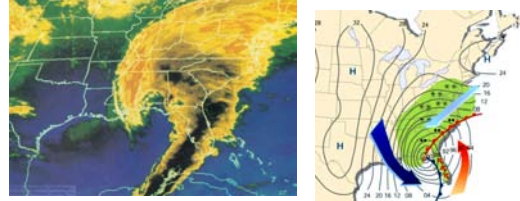
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Mid-latitude Storms

Storm Patterns



- How can S.C. have a major snowfall?



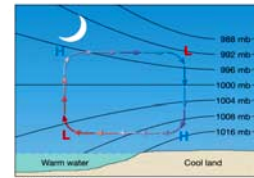
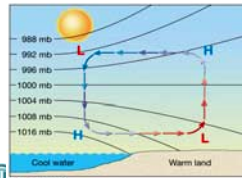
Winds - Local Scale

- At the coast, during the warm months the prevailing weather pattern is the daily development of a land/sea breeze



Land/Sea Breeze

- Sea breeze can cool the air temperature 5 -10 °C
- Can extend 100 km inland - usually 5-15 km
- Strongest winds in sea breeze located right on coast
- Land breezes are weaker than sea breezes



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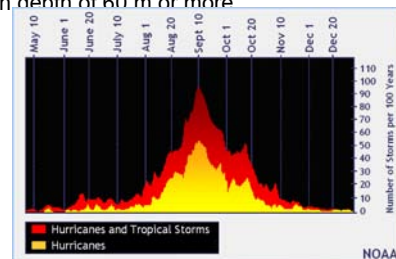
Hurricane Energy

- Hurricanes pull energy out of the ocean (evaporation), later release it into the atmosphere (conduction)
- How much energy?



Hurricane Season

- Thick lens of warm water
 - SST of at least 26.5 °C (80 °F) through an ocean depth of 60 m or more



NOAA

- Classified by sustained wind speed

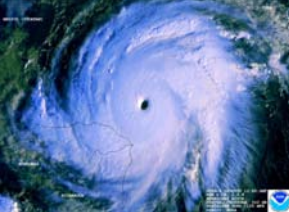



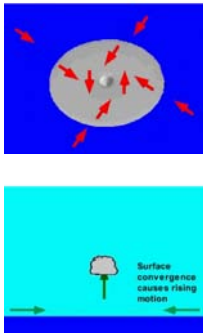

Table 12-2 The Saffir-Simpson Scale

Category	Pressure mb	Wind Speed km/hr	Wind Speed mph	Storm Surge m	Storm Surge ft	Damage
1	≥ 980	119-154	74-95	1-2	4-5	Minimal
2	965-979	155-178	96-110	2-3	6-8	Moderate
3	945-964	179-210	111-130	3-4	9-12	Extensive
4	920-944	211-250	131-155	4-6	13-18	Extreme
5	< 920	> 250	> 155	> 6	> 18	Catastrophic



How do hurricanes strengthen?

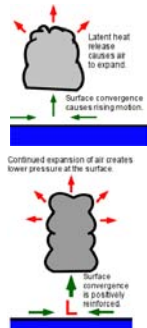

- 1) Winds blow from H to L; Wind speed depends on difference in pressure
- 2) Surface convergence forces air to rise
- 3) Evaporation depends on Wind Speed $Q_e = c(q_s - q_a)W$. Air and moisture rises into the storm.
- 4) Rising moist air cools & forms clouds


How do hurricanes strengthen?

- 5) Condensing air releases heat; heats surrounding air
- 6) Air rises more; surface pressure drops
- 7) Larger pressure gradient; faster winds
- 8) Faster winds, more evaporation
- 9) More evaporation, more latent heat released
- 10) And on, and on, and on


- Perfect POSITIVE FEEDBACK system

Hurricane Structure



- Eye
 - Almost cloudless skies, subsiding air, light winds
 - Diameter: 10 to 65 km
 - Eye shrinks as hurricane intensifies
 - Lowest pressure in the storm
- Eye Wall
 - Most intense winds and rainfall
 - 20-60 km thick



Hurricane Structure

- Moving outward from the eye wall are a series of Spiral Rain Bands
- Alternating bands of thunderstorms, possible tornadoes, high winds & heavy rainfall with areas of sinking rain-free air