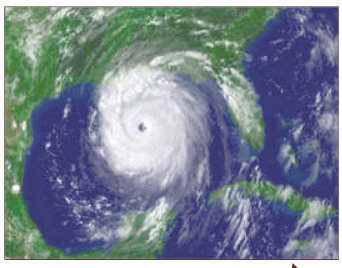
Chapter Outlines



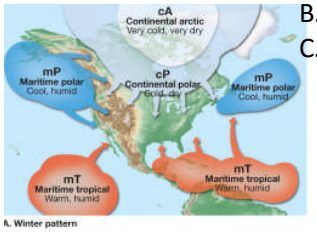
Hurricane Katrina

NOTE: This is intended to help students 'organize' their understanding of each topic. It is <u>not</u> a comprehensive study guide for quizzes or midterms, i.e. <u>study your text!</u>

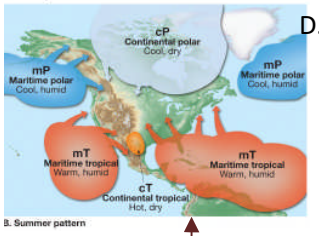
Weather Patterns & Severe Weather

I. Air masses

A. Characteristics: large body of air *(1600 km or more across),* several km thick, similar T° throughout, similar moisture throughout, moves and affects a large portion of a continent



A. Winter pattern



B. Summer pattern

Air masses

B. **Source region**—the area where an air mass acquires its properties

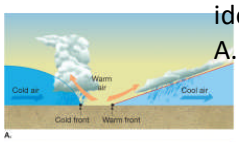
C. **Classification** of an air mass - two criteria are used to classify air masses

1. By latitude of source region: Polar (**P**) - high latitudes, cold; Tropical (**T**) - low latitudes, warm
2. By nature of surface in the source region: Continental (**c**) - forms over land, likely to be dry; Maritime (**m**) - originates over water, humid air
3. Four basic types of air masses: **Continental polar (cP)** , **Continental tropical (cT), Maritime polar (mP**), **Maritime tropical (mT)**

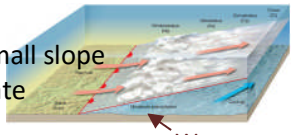
D. Air masses and weather

1. North America <u>east of the Rocky Mountains</u>
   a. Continental polar (**cP**)
      i. From northern Canada - winter brings cold dry air, summer brings cool relief
      ii. Responsible for lake-effect snows - **cP** air mass crosses the Great Lakes, picks up moisture from the lakes, and snow falls on the leeward shores of the lakes
   b. Maritime tropical (**mT**) - sources are the Gulf of Mexico and the Atlantic Ocean, warm moist unstable air, and brings precipitation to the eastern United States
2. Continental tropical (**cT**) - from <u>SW and Mexico</u>, hot dry and seldom important outside this region
3. Maritime polar (**mP**) - brings precipitation to the <u>western mountains</u>, occasional influence in the northeastern U.S.

II. Fronts - boundary that separates air masses of different T° and densities - air masses retain their identities, warmer less dense air forced aloft, cooler denser air acts as wedge below

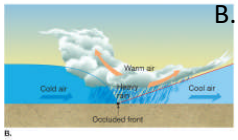


A.

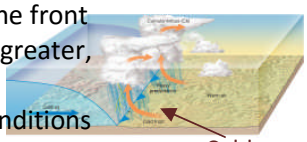


Warm front

A. **Warm front** - warm air replaces cooler air, shown on a map by a line with semicircles, small slope (1:200), clouds become lower as the front nears, slow rate of advance, light-to-moderate precipitation, T^{o} increase with the passage of the front



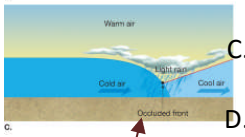
B.



Cold front

B. **Cold front** - cold air replaces warm air, shown on a map by a line with triangles, twice as steep (1:100) as warm fronts, advances faster than a warm front, T^{o} decrease with the passage of the front

1. Associated weather is more violent than a warm front - intensity of precipitation is greater, duration of precipitation is shorter
2. Weather behind the front is dominated by - cold air mass, subsiding air, clearing conditions



C.

Cold front overtakes Warm front & creates Occluded front

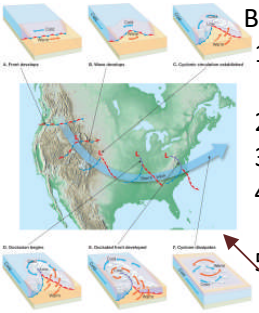
C. **Stationary front** - flow of air on both sides of the front is almost parallel to the line of the front, surface position of the front does not move

D. **Occluded front** - active cold front overtakes a warm front, cold air wedges the warm air upward, weather is often complex, precipitation is associated with warm air that is forced aloft

III. Middle-latitude cyclone - The primary weather producer in the middle-latitudes

A. **Cyclone** – a low pressure system, with surface convergence, and outflow *(divergence)* aloft; **Anticyclone** – a high pressure system, with surface divergence, and convergence aloft

B. Life cycle

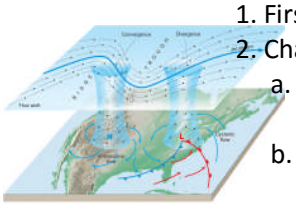


Life of a mid-latitude cyclone

1. First, air masses are moving parallel to a front in opposite directions past each other - Continental polar (**cP**) air is often north of the front, maritime tropical (**mT**) air is often south of the front
2. Frontal surface takes on a 'wave' shape with low pressure centered at the apex of the wave
3. Flow of air begins a counterclockwise cyclonic circulation, thus forming a warm front and cold front
4. If cold front catches up to warm front an occluded front is produced, and warm sector is displaced aloft
5. Eventually pressure gradient weakens and fronts fade, and storm dies away

C. Idealized weather sequence consists of mid-latitude cyclones moving eastward across the U.S.

1. First signs of their approach are in the western sky, with 2 to 4 days required to pass over a region
2. Changes in weather associated with the passage of a mid-latitude cyclone *(may vary with path)*
   a. **Warm front -** 1. Clouds become lower and thicker, 2. Light precipitation, 3. After the passage of a warm front winds become more southerly, and warmer T° is experienced (**mT** air mass)
   b. **Cold front -** 1. Wall of dark clouds, 2. Heavy precipitation *(hail & occasional tornadoes),* 3. After the passage of a cold front wind becomes north to northwest T° drops as a **cP** air mass moves in and clearing skies

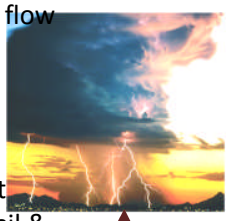

Overlay of jet stream

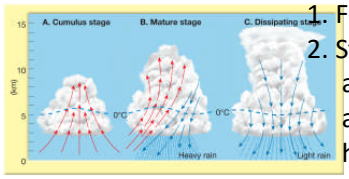
D. **Role of airflow aloft -** cyclones & anticyclones are generated and maintained by upper-level air flow

IV. Severe weather types

A. **Thunderstorms** – can occur anywhere, but mostly in Florida and eastern Gulf Coast region

1. Features include - cumulonimbus clouds, heavy rainfall, lightning, occasional hail
2. Stages of development – require warm moist unstable air, high surface T°, usually afternoon and early evening, convection causes condensation & release of latent heat and then stronger updrafts, updrafts & downdrafts form, gusty winds & lightning & hail & heavy precipitation, cooling effect of precipitation marks the end

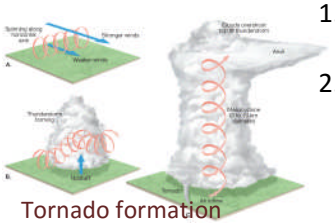

Cumulonimbus



Thunderstorm formation

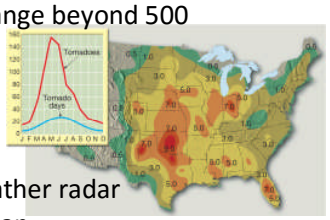
B. **Tornadoes** - are local storms of short duration

1. Features - violent windstorm, rotating column of air that extends down from a cumulonimbus cloud, extreme low pressures inside causes the air to rush in
2. Occurrence and development – U.S. Midwest is most dangerous tornado area in world
   a. Average of over 700 each year in the U.S. most frequently from April through June, associated with severe thunderstorms, exact cause of tornado formation is speculative
   b. Conditions for the formation of tornadoes - occur most often along a cold front, during the spring months, & associated with huge thunderstorms


Tornado formation

4. Characteristics – between 150 and 600m dia., speed across landscape is about 45 km/hr, cut about a 10 km long path, most move toward the northeast, maximum winds range beyond 500 km/hr, intensity measured by the Fujita intensity scale...EF-0 thru EF-5.
5. Tornado forecasting – forecasting is difficult because of their small size
   a. **Tornado watch** - alerts the public to the possibility of tornadoes, issued when the conditions are favorable
   b. **Tornado warning** - is issued when a tornado is sighted or is indicated by weather radar

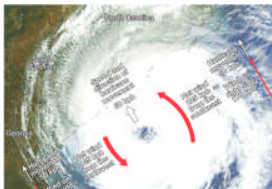

Tornado



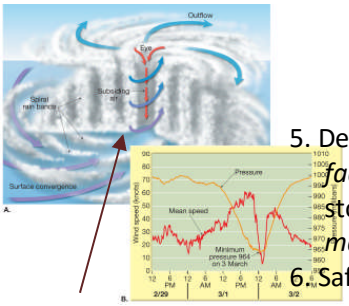
"Tornado Alley"

C. **Hurricanes** – called **typhoons** in the western Pacific, and **cyclones** in the Indian Ocean

1. Normally forming between 5° and 20° latitude, are Earth's most violent storms
2. By definition it has wind speed in excess of 119 km/hr, and rotary cyclonic circulation
3. Parts of a hurricane include:
   a. **Eye** - at the very center, about 20 km in dia., precipitation ceases, winds subside, air gradually descends and heats by compression, warmest part of the storm
   b. **Eyewall** - near the center, rising air, intense convective activity, wall of cumulonimbus clouds, greatest wind speeds, heaviest rainfall
   c. Wind speeds can reach 300 km/hr thereby generating 50-foot waves at sea
4. Hurricane formation and decay *(many variations of this explanation exist)*
   a. Several thunderstorms *(a group)* occur in a local area of the ocean by chance, these storms draw moisture up into the troposphere, this moisture condenses releasing latent heat thus creating more updraft, this creates a large area of low pressure, winds begin to move towards the low pressure with the Coriolis effect causing them to spin, this process continues to build as long as warm ocean water is available to 'fuel' it. Once winds exceed 74mph it has become a hurricane. Strength diminishes and dies when it moves over cooler water or land.
5. Destruction from a hurricane depends on & includes - strength of storm *(the most important factor),* elevation of affected land, size and population density of the area affected, size of storm surge *(large dome of ocean water 65 to 80 km wide sweeps across the coast where eye makes landfall),* wind damage, inland flooding from torrential rains after storm reaches land
6. Saffir–Simpson scale ranks the relative intensities of hurricanes in categories of 1 through 5


Hurricane


Result of a very strong wind



Structure inside a hurricane


Average hurricane tracks