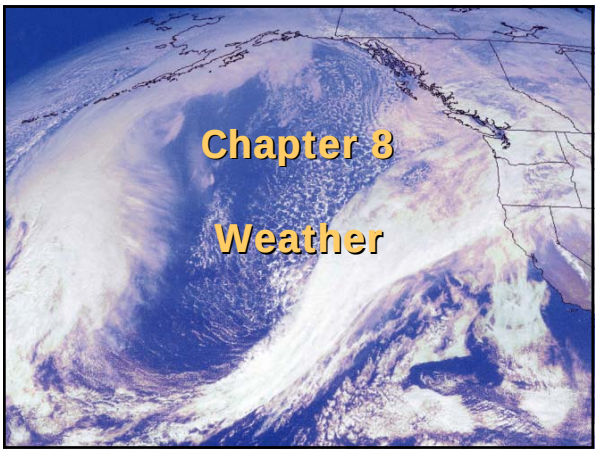
Physical Geography

GEOGRAPHY 1710

DAVID R. SALLEE



Chapter 8

Weather

Precipitation

Ice Crystal Formation - In much of the world precipitation is produced by ice crystal formation. Rain clouds extend high enough to have temperatures below freezing, where ice crystals and super-cooled water droplets coexist in the cloud. Both are in direct competition for the water vapor that is not yet condensed, and the results are that most goes to the ice crystals while the remaining water droplets evaporate to replenish the diminishing supply of water vapor. The large ice crystals may precipitate as snowflakes or melt and fall to Earth as rain.

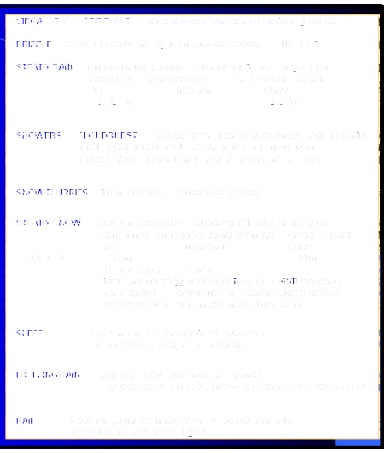
Collision/Coalescence - In some areas, such as the tropics, rain is produced by collision and coalescing of water droplets. These droplets collide and coalesce to form larger and larger droplets until they are large enough to fall to the Earth as rain.

Precipitation Types

Most clouds form when moist air is uplifted and cooled.

Air is stable if it resists uplift or unstable if it promotes uplift.

Stability depends on the lapse rate = how quickly the air cools with increasing altitude.



Weather

- Air Masses
- Atmospheric Lifting Mechanisms
- Midlatitude Cyclonic Systems
- Violent Weather

Air Masses

Air Mass is an extremely large body of air whose properties of temperature and moisture content (humidity), at any given altitude, are fairly similar in any horizontal direction.

- can cover hundreds of thousands of square miles.
- there can be small variations

Source Regions are simply geographic areas where an air mass originates. Should be:

1. uniform surface composition - flat
2. light surface winds

Air Masses

The longer the air mass stays over its source region, the more likely it will acquire the properties of the surface below.

Classification: 4 general air mass classifications categorized according to the source region.

1. polar latitudes P - located pole-ward of 60 degrees north and south
2. tropical latitudes T - located within about 25 degrees of the equator
3. continental c - located over large land masses--dry
4. marine m - located over the oceans----moist

Air masses in the U.S. include

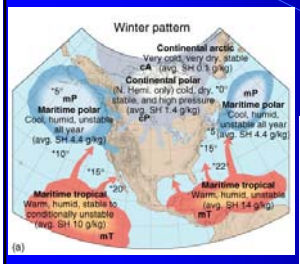
cP -- wintertime bitter cold can extent to Southern US and even Florida causing crop damage. Require long, clear nights, which means strong radiational cooling of air near the surface.

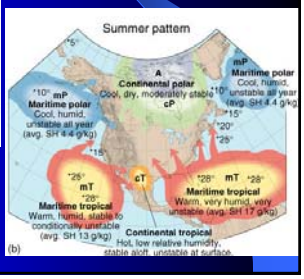
mP -- Winter cP air moves over a region such as the NE Pacific, picking up some warmth and moisture from the warmer ocean.

mT -- wintertime source for the SW US is the subtropical East Pacific Ocean. mT air that influences weather east of the Rocky Mountains comes from the Gulf of Mexico, but only influences winter weather in the SE states.

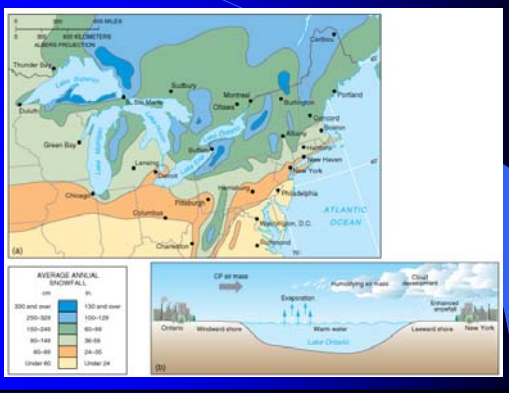
cT -- Continental tropical air usually only influences the US in summertime as warm, dry air is pumped up off of the Mexican Plateau. It is usually fairly stable and dry, and if it becomes stagnant over the midwest, results in a drought.

Air Masses





Air Mass Modification



Atmospheric Lifting Mechanisms

- Convergent Lifting
- Convectional Lifting
- Orographic Lifting
- Frontal Lifting (Cold and Warm Fronts)

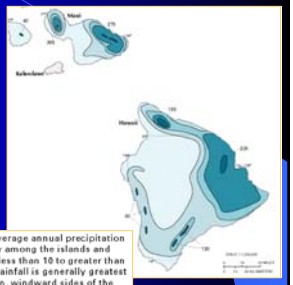
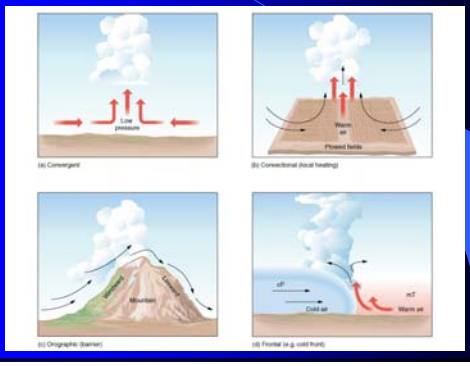
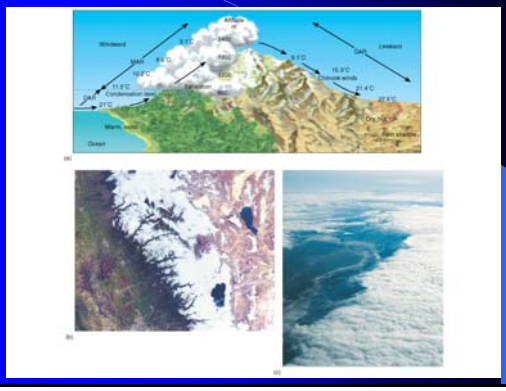


Figure 34. Average annual precipitation varies greatly among the islands and ranges from less than 10 to greater than 400 inches. Rainfall is generally greatest on the eastern, windward sides of the islands and in areas between 2,000 and 6,000 feet above sea level. Niihau, Lanai, and Kahoolawe receive little rainfall because they are in rain shadows that are formed by larger islands.

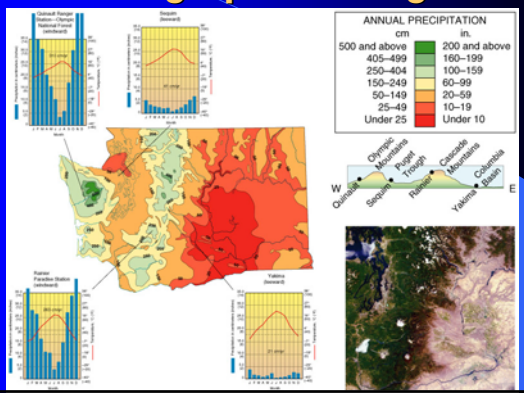
Atmospheric Lifting Mechanisms



Orographic Lifting



Orographic Lifting



Frontal Lifting

- Cold Fronts
  - Cold air forces warm air aloft
  - 400 km wide (250 mi)
- Warm Fronts
  - Warm air moves up and over cold air
  - 1000 km wide (600 mi)

Fronts

Front is the transition zone between air masses with distinctly different properties.
The differences in density are most often caused by temperature differences. Separate air masses with different humidities as well. We identify fronts by the movement of this transition zone and the properties that move over a geographical location. What weather changes do you expect when TV weather person says a cold front is moving through the area?
How do you identify a front on a surface weather map or by your own weather observations?
Look for:

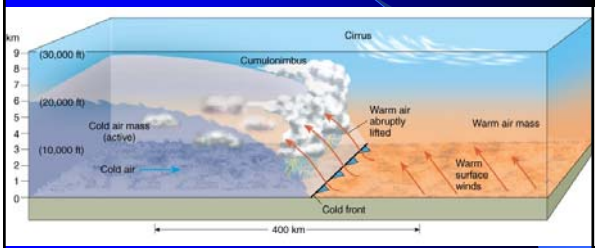
1. Sharp temperature changes over a relatively short distance
2. Change in moisture content
3. Rapid shifts in wind direction
4. Pressure changes
5. Clouds and precipitation patterns

Fronts

A cold front is cold air displacing warm air.
Steep leading edge -- friction slows surface advance, moves quickly--25 knts up to 40 knts faster=steeper

Temperature: Warm Sudden decrease Steady Cooling
Winds: S-SW gusty W-NW
Dew Point: high; remains steady Steady Decreases
Pressure: Falling steadily Minimum; rapid rise steady
Visibility: Fair to Poor Poor then improving good
Clouds: Ci, Cs Cb Cb Cu
Precipitation: showers heavy precipitation, clearing

Cold Front

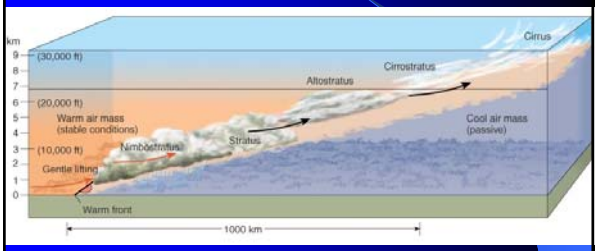


Fronts

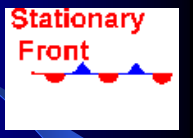
A warm front is warm air displacing cool air diagram. Shallow leading edge warm air must "overrun" cold air--cold air recedes moves slow 10-15 knts

Temperature: Cool, slowly warming steady rise warmer
Dew Point: Steady Rise Steady Increases than steady
Pressure: Usually Falling Levels off slight rise, followed by fall
Visibility: Poor Improving fair
Clouds: Ci, Cs As Ns St fog Stratus clearing with scattered Sc
Precipitation: light to moderate drizzle or nothing usually none

Warm Front



Fronts



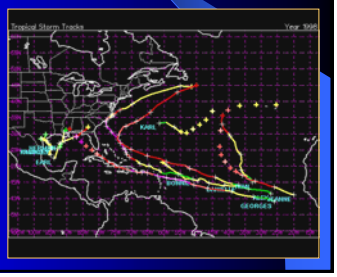
A stationary front is characterized by no movement of the transition zone between two air masses.

There are two kinds of occluded fronts

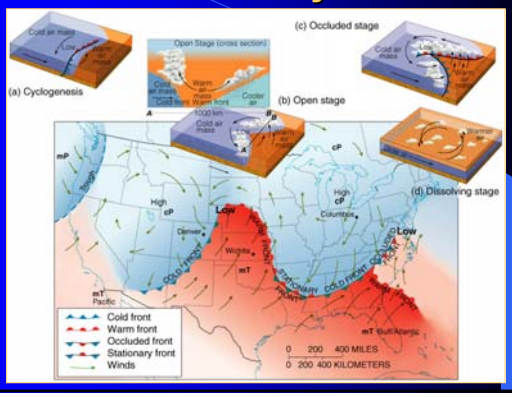
Cold occlusion-cold front catches up with warm front. Ns, Tcu,Cb warm very cold
Warm occlusion mostly in NW. Warm cool mP off ocean cold cP warm occlusion. Precipitation is similar to the cold occlusion

Life Cycle of a Midlatitude Cyclone

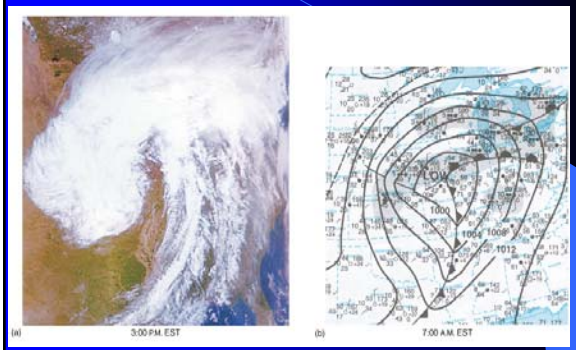
- Cyclogenesis – (birth of a cyclone)
- Open stage
- Occluded stage
  - Occluded front
  - Stationary front
- Dissolving stage
- Storm tracks



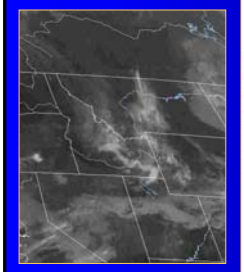
Midlatitude Cyclone

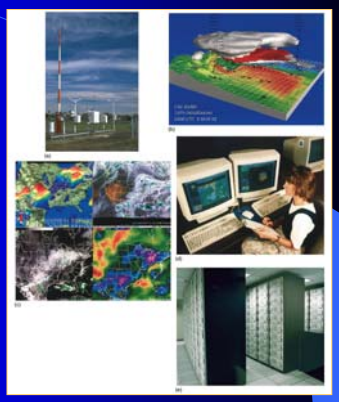


Midlatitude Cyclone

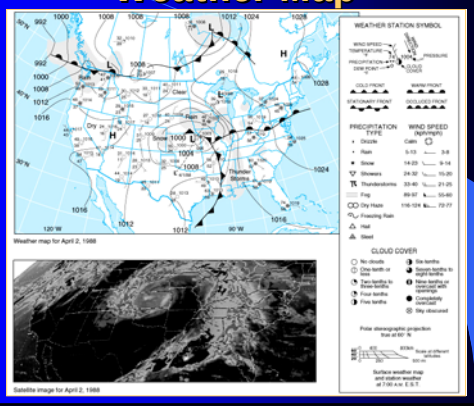


Weather Forecasting





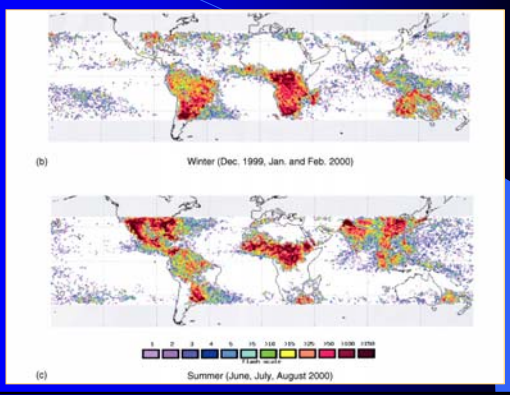
Weather Map



Violent Weather

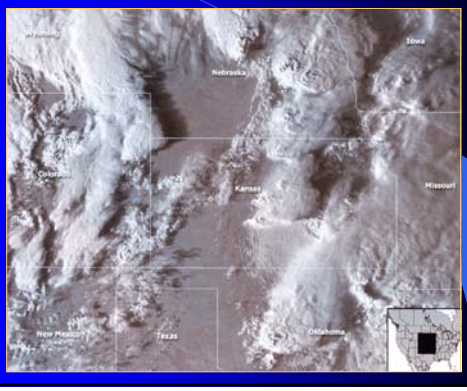
- Thunderstorms
- Tornadoes
- Tropical Cyclones

Thunderstorms

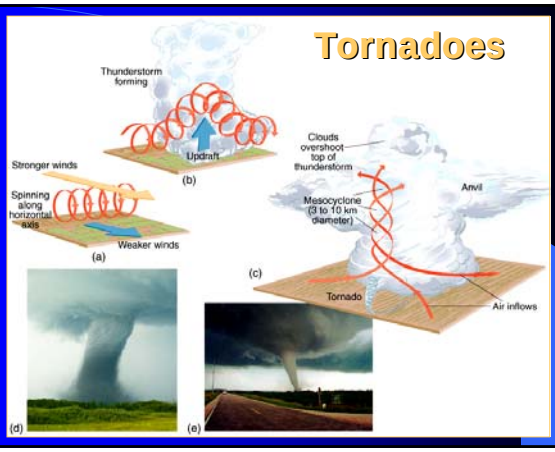


Thunderstorms

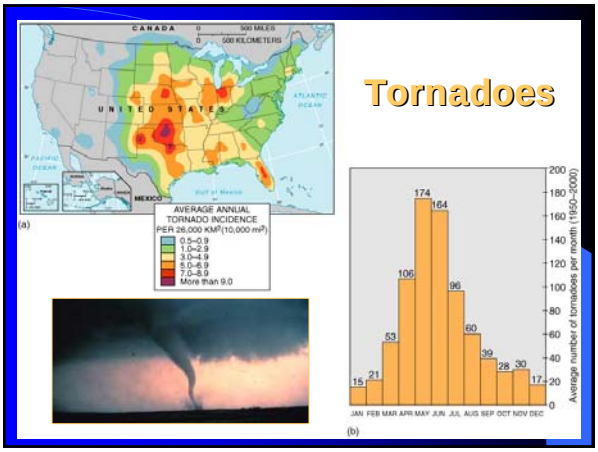
Thunderstorms



Tornadoes



Tornadoes



Tornadoes

1. A large, layered sandwich develops in the atmosphere. Hot, humid air is trapped beneath cold, dry air.

2. The "cap" (a layer of stable air between the hot and cold air) is disturbed by winds in the upper atmosphere or by the arrival of a weather front.

3. Lower-level air rises and expands in the reduced air pressure aloft.

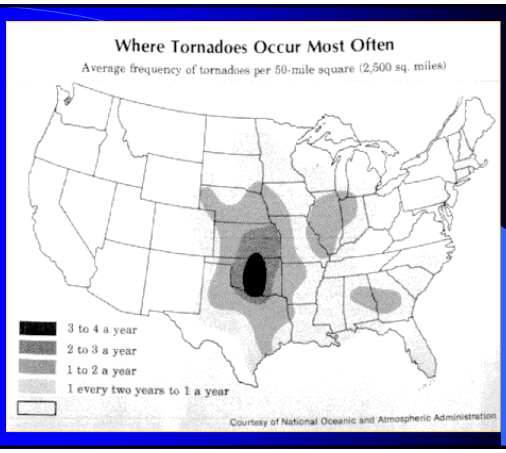
Tornadoes

4. As the air cools, moisture condenses, releasing latent heat which warms the air, making it buoyant, and causing it to rise at speeds up to 150 mph. By now, the cloud is a thunderstorm. Upper-level winds tilt the thunderhead, creating the anvil shape.

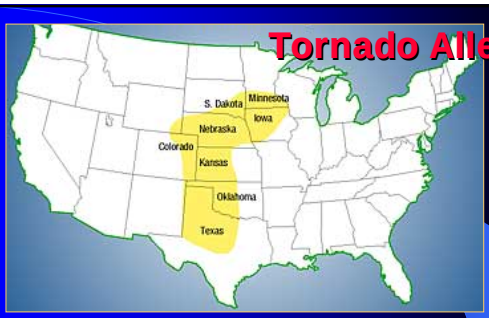
5. The thunderstorm may die out in intense rain and/or hail. Or it may spawn a tornado.

6. Interactions between air at various altitudes, humidities and temperatures cause rain, lightning, air circulation and strengthening of the rotating updraft, now called a "mesocyclone." Low-level wind helps cause this rotation, which is almost always counter-clockwise (seen from above) in the Northern Hemisphere.

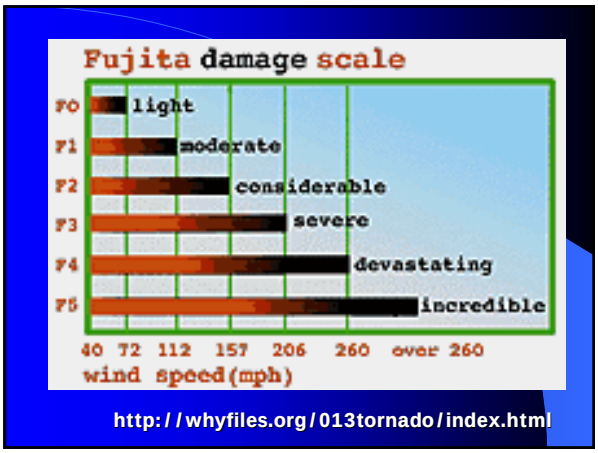
7. A tornado may form below the mesocyclone. As the spinning air column narrows, it rotates faster and extends higher into the storm.



Tornado Alley



Tornado Alley includes parts of Texas, Oklahoma, Kansas, Nebraska, eastern Colorado and western Iowa, and is characterized by a high frequency of strong and violent tornadoes and a relatively consistent season from year to year.


Fujita damage scale
F0 light
F1 moderate
F2 considerable
F3 severe
F4 devastating
F5 incredible
40 72 112 157 206 260 over 260
wind speed(mph)
http://whyfiles.org/013tornado/index.html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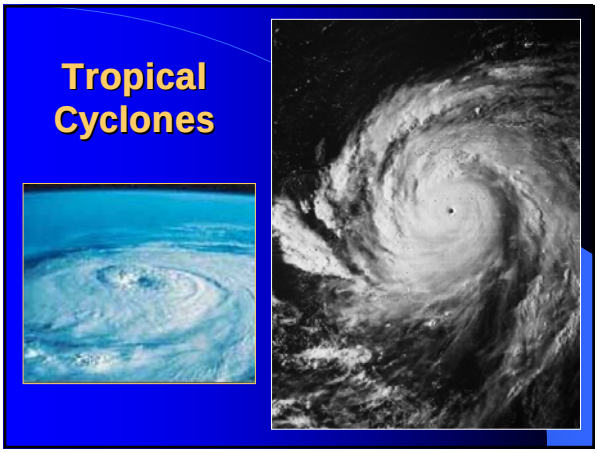
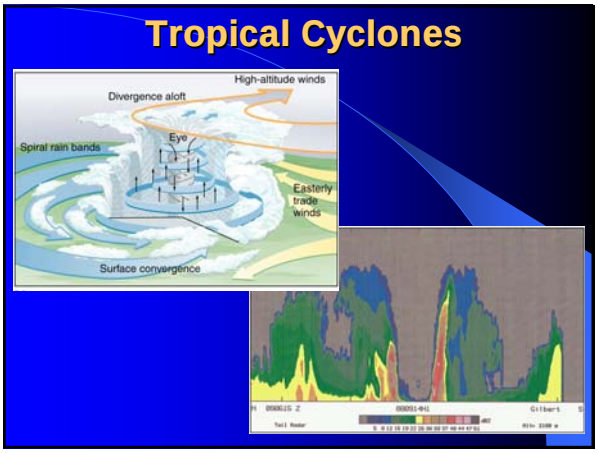
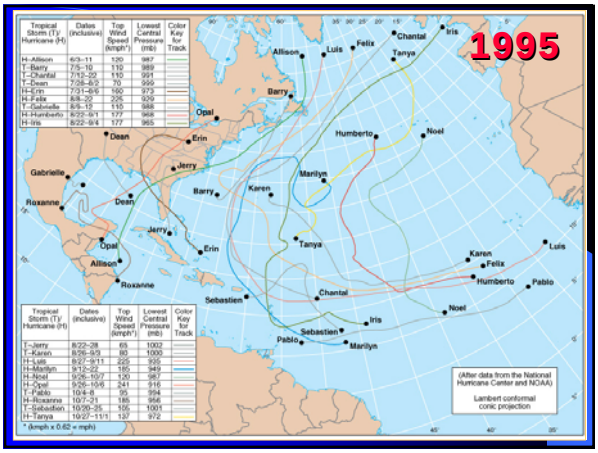
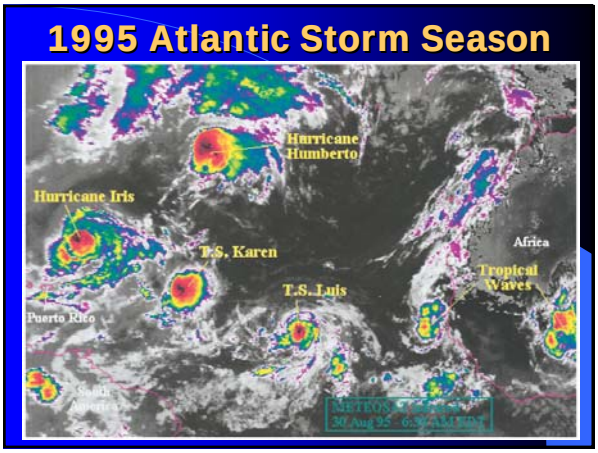
Wichita Falls Tornado


Tropical Cyclones

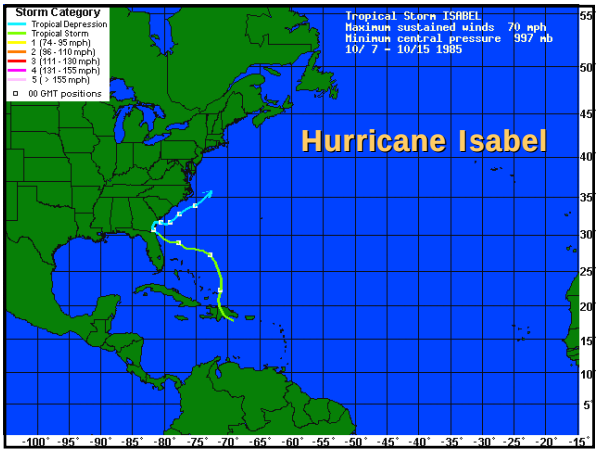

Tropical Cyclones
High-altitude winds
Divergence aloft
Spiral rain bands
Eye
Easterly trade winds
Surface convergence


1995
Allison
Luis
Felix
Chantal
Iris
Tanya
Barry
Opal
Dean
Erin
Humberto
Noel
Jerry
Gabrielle
Marilyn
Karen
Roxanne
Sebastien
Pablo
(After data from the National Hurricane Center and NOAA)
Lambert conformal conic projection

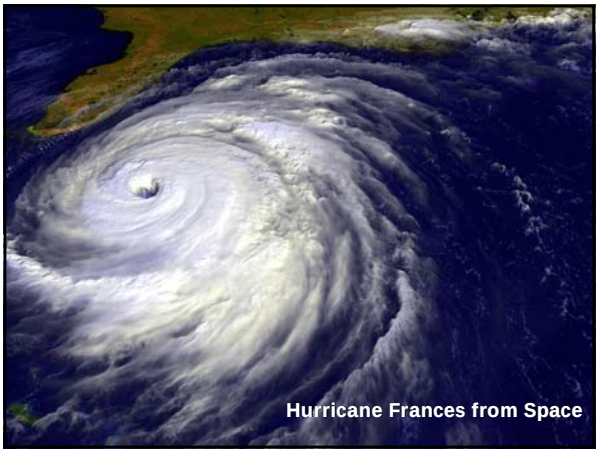

1995 Atlantic Storm Season
Hurricane Humberto
Hurricane Iris
T.S. Karen
T.S. Luis
Africa
Tropical Waves
Puerto Rico


Hurricane
Andrew
Hurricane Andrew
August 1992
Positions at
7 A.M. E.D.T.
922 mb
ATLANTIC
OCEAN
(a)
(b)


Hurricane
Andrew


Storm Category
Tropical Depression
Tropical Storm
1 (74 - 95 mph)
2 (96 - 110 mph)
3 (111 - 130 mph)
4 (131 - 155 mph)
5 (> 155 mph)
00 GHT positions
Tropical Storm ISABEL
Maximum sustained winds 70 mph
Minimum central pressure 997 mb
10/ 7 - 10/15 1985
Hurricane Isabel


Hurricane Isabel
at sea


Hurricane Frances from Space