

Weather

BIG QUESTION:

How do meteorologists predict weather?

What is Weather?

The atmospheric conditions, along with short-term changes, of a certain place at a certain time

Variables:

Temperature

Rainfall/precipitation

Barometric Pressure

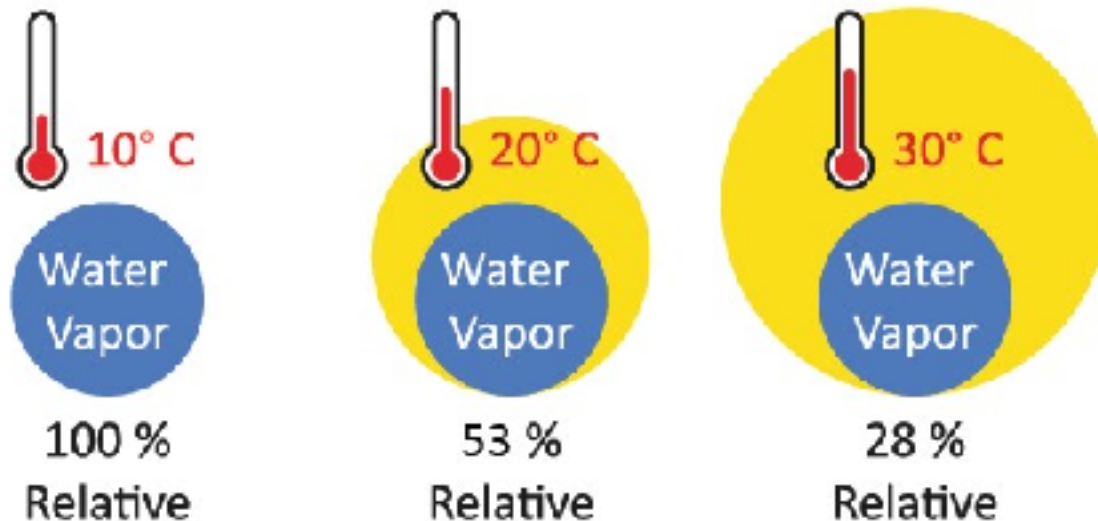
Wind speed & direction - moves from area of high pressure to low

Humidity

Cloud coverage

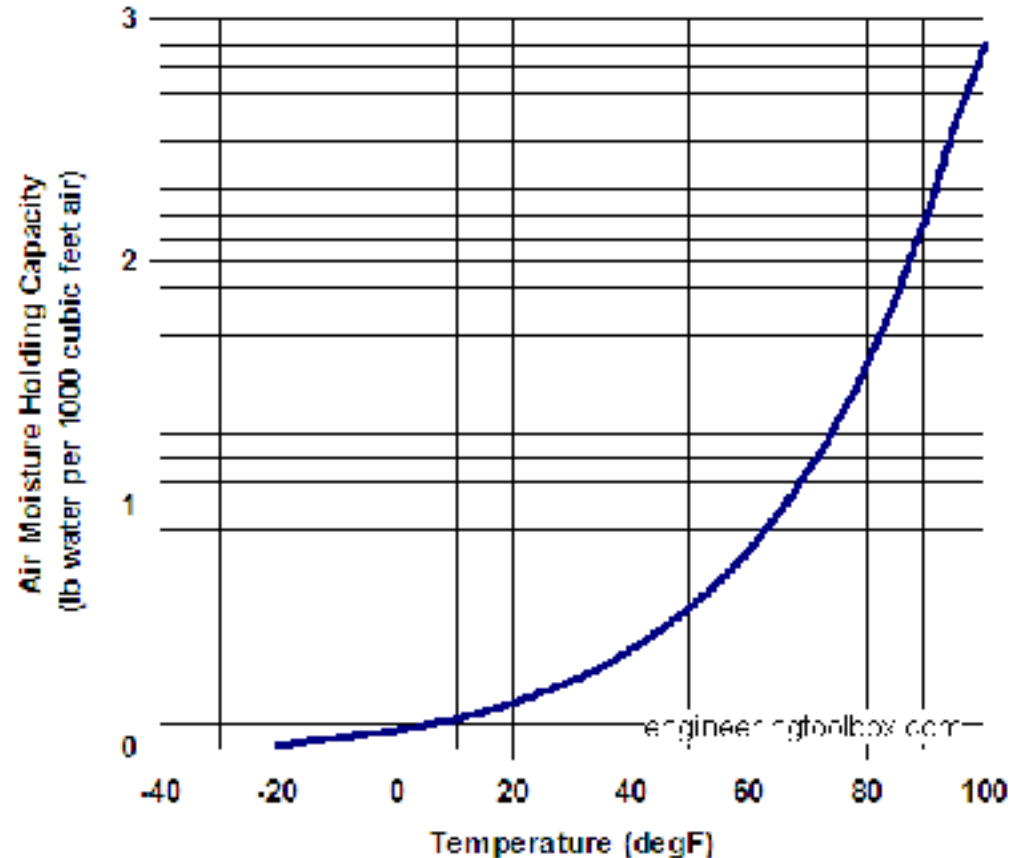
Relative Humidity

- **Humidity** is the amount of water vapor in the air
- **Relative humidity** is the percentage of water vapor that is actually in the air compared to the maximum amount of water vapor it can hold
- Psychrometer: instrument that measures Relative Humidity



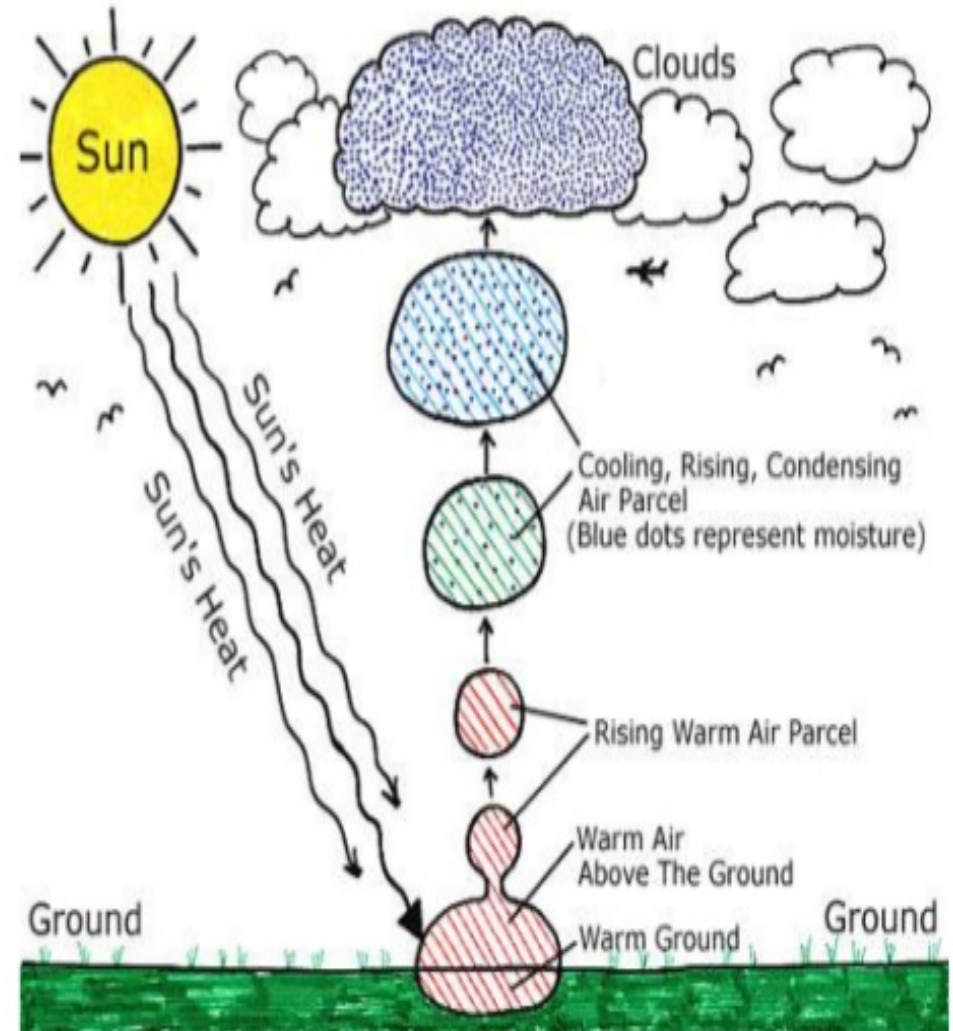
Dew Point - the temperature at which air is SATURATED and condensation can occur

The higher the temperature of the air, the more water it can hold before it reaches saturation (dew point)



Clouds

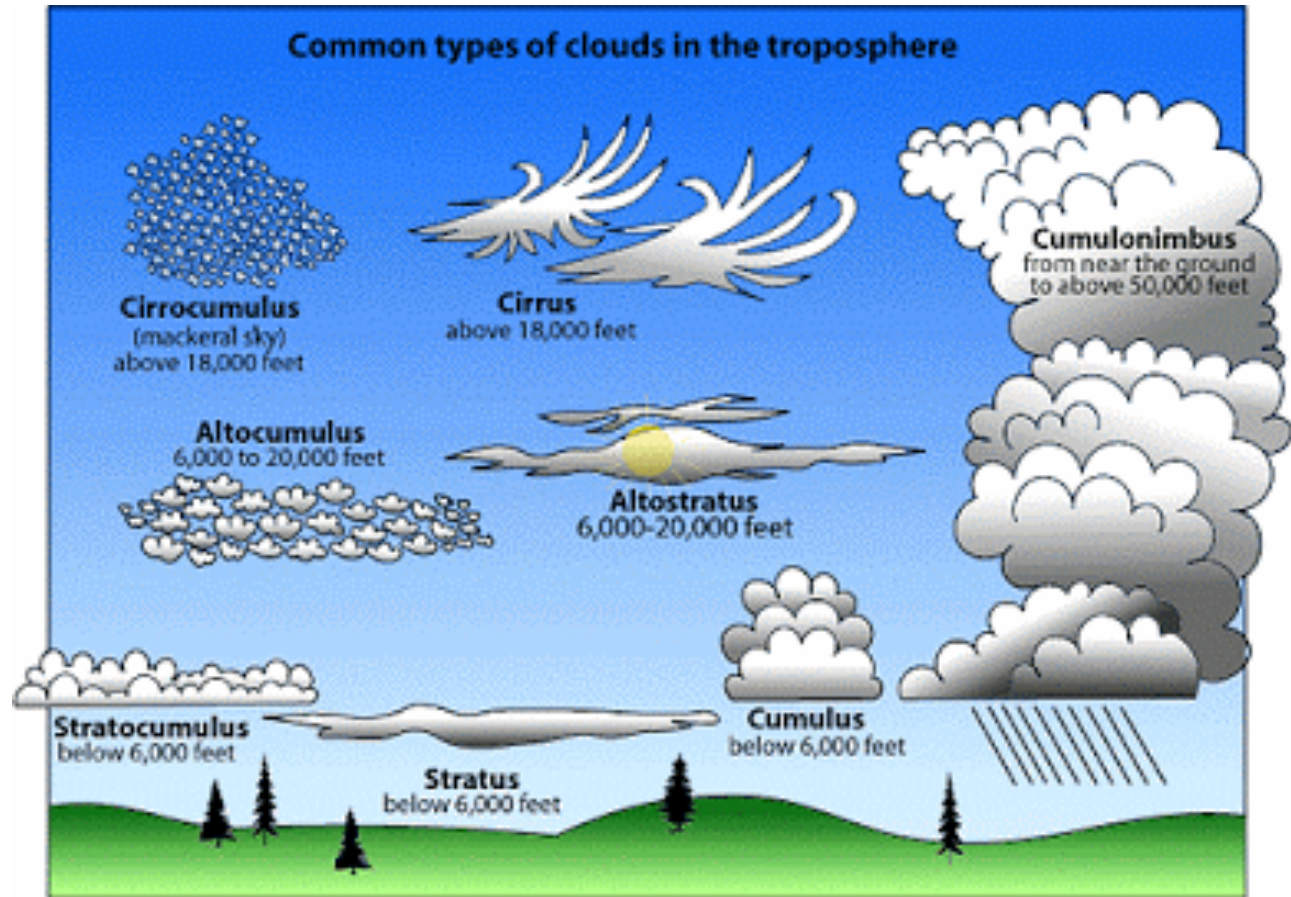
- Cold air holds less water vapor than warm air
- As air cools the amount of water vapor it can hold decreases
- The water will condense into droplets or ice crystals
- **DEW POINT**: The temperature at which condensation begins
- For clouds to form there must be particles in the air for droplets of water to condense upon



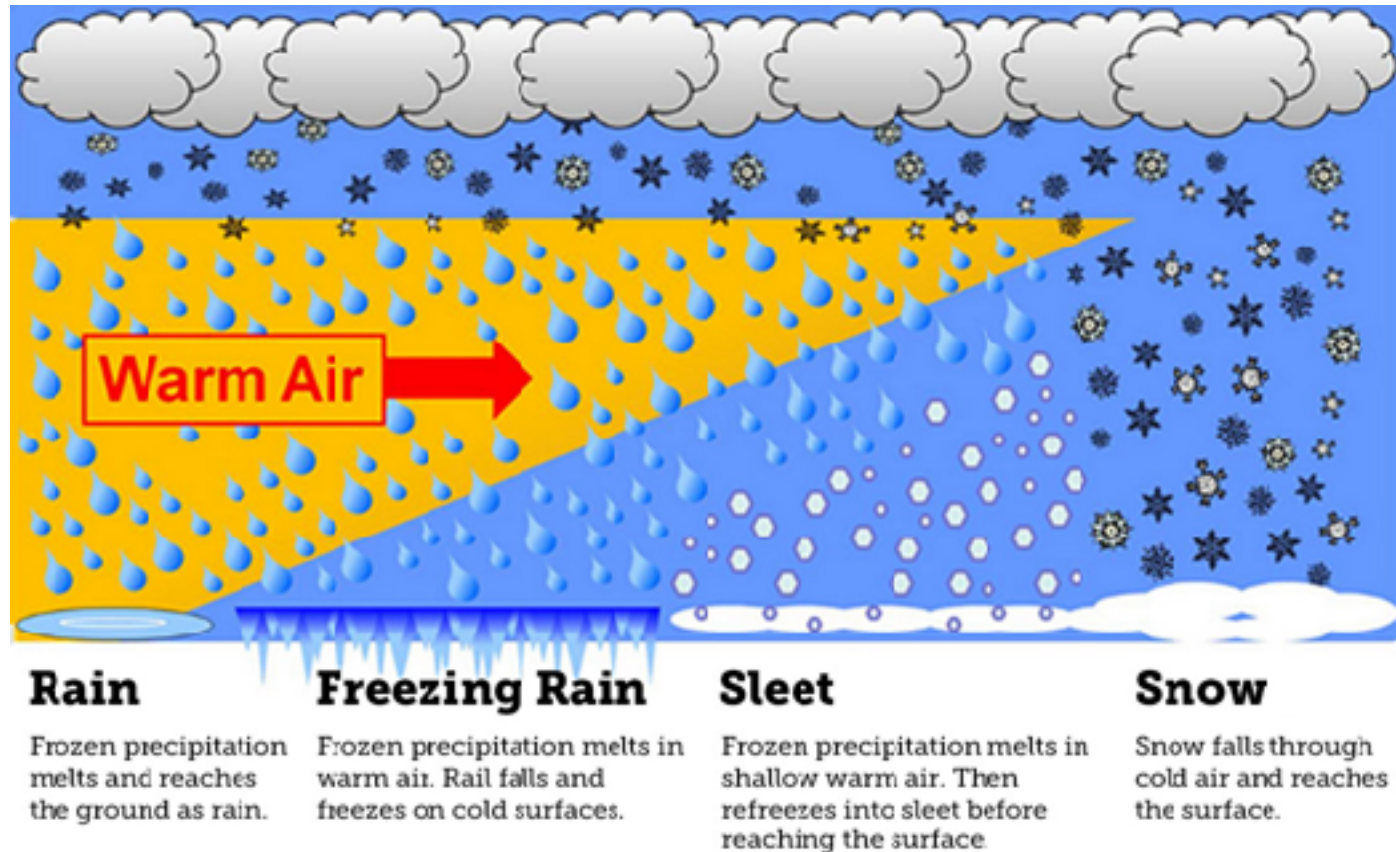
Types of Clouds

- **High altitude:**
Cirrus - thin, wispy
Above 6km & low temp.
- **Medium altitude:**
Altostratus & Altopumulus
Between 2km-6km, indicate precipitation
- **Low altitude:**
Cumulus/Stratus (fair-weather clouds)
& Cumulonimbus (storm clouds)
Less than 2km above ground

FOG - ground level clouds

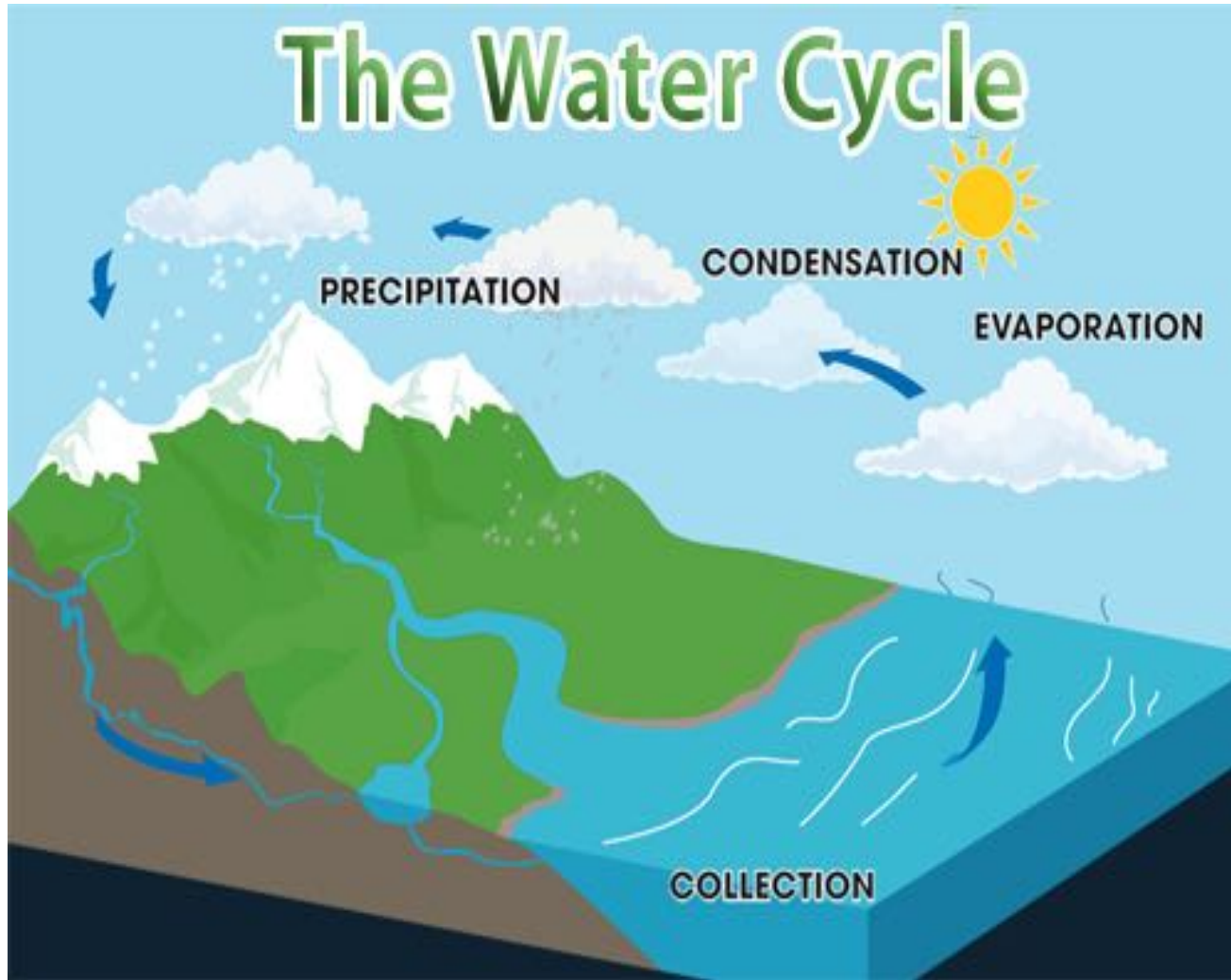


Precipitation



- Any form of water that falls from clouds to the ground
- Rain, Sleet, Freezing rain, snow and hail
- Rain gauge: measures amount of precipitation
- Snowfall is measured with a ruler/meter stick or by melting and measuring amount of water

Water in the Atmosphere



- In the Water cycle, water moves from plants, lakes, rivers and oceans into the atmosphere and falls back to Earth.
- Collection → Evaporation → Condensation → Precipitation

Using a Rain Gauge

- If it has NO funnel - read the amount of rainfall with a ruler or using the scale on the gauge
- If it **DOES HAVE** a funnel attached to the top: You must read the scale and divide by 10
 - (the funnel helps collect 10 times the amount of water)
- **SNOWFALL** - use a ruler to measure depth - ON AVERAGE
- 10 centimeters of snow = 1 centimeter of rain



Floods and Droughts

Flood: overflowing of water in a normally dry area

- Small or large, many floods occur when the volume of water in a river increases so much that the river overflows its channel.

Drought: a long period of scarce rainfall or dry conditions

- Droughts are caused by dry weather systems that remain in place for weeks or months at a time.



Lesson 2 - Weather Patterns

Pressure systems

High Pressure: at the center and lower pressure outside of the system - the air inside the system moves AWAY from the center, dense air sinks = clear skies and fair weather

Low Pressure: at the center with higher pressure outside of the system - the air inside RISES, cools and the water vapor condenses, forming clouds and precipitation

Air Masses

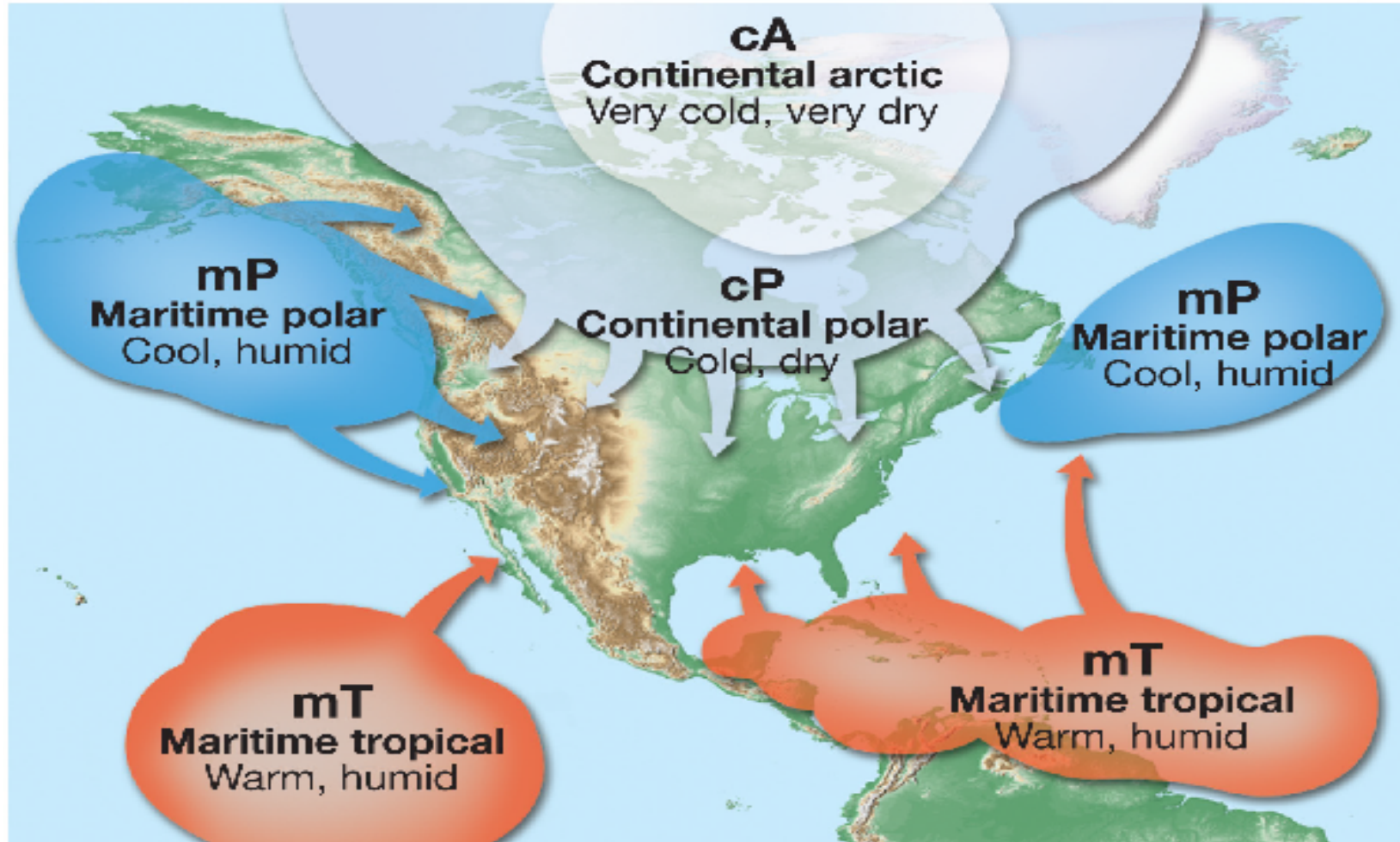
- **Air Mass**: a huge body of air in the lower atmosphere that has similar temperature, humidity and air pressure at any given height.

North America's 4 Main Air Masses:

Maritime tropical
Continental tropical
Maritime polar
Continental polar

<u>Airmass Name</u>	Abbreviation	Where it Forms	Characteristic Weather
Maritime Polar	<u>mP</u>	Cold Ocean	Cool and Humid
Maritime Tropical	<u>mT</u>	Warm Ocean	Warm and Humid
Continental Polar	<u>cP</u>	Cold Land	Cool and Dry
Continental Tropical	<u>cT</u>	Warm Land	Warm and Dry
Continental Arctic	<u>cA</u>	Extreme North	Very Cold Very Dry

Winter Pattern Air Mass over North America



A. Winter pattern

How Air Masses Move

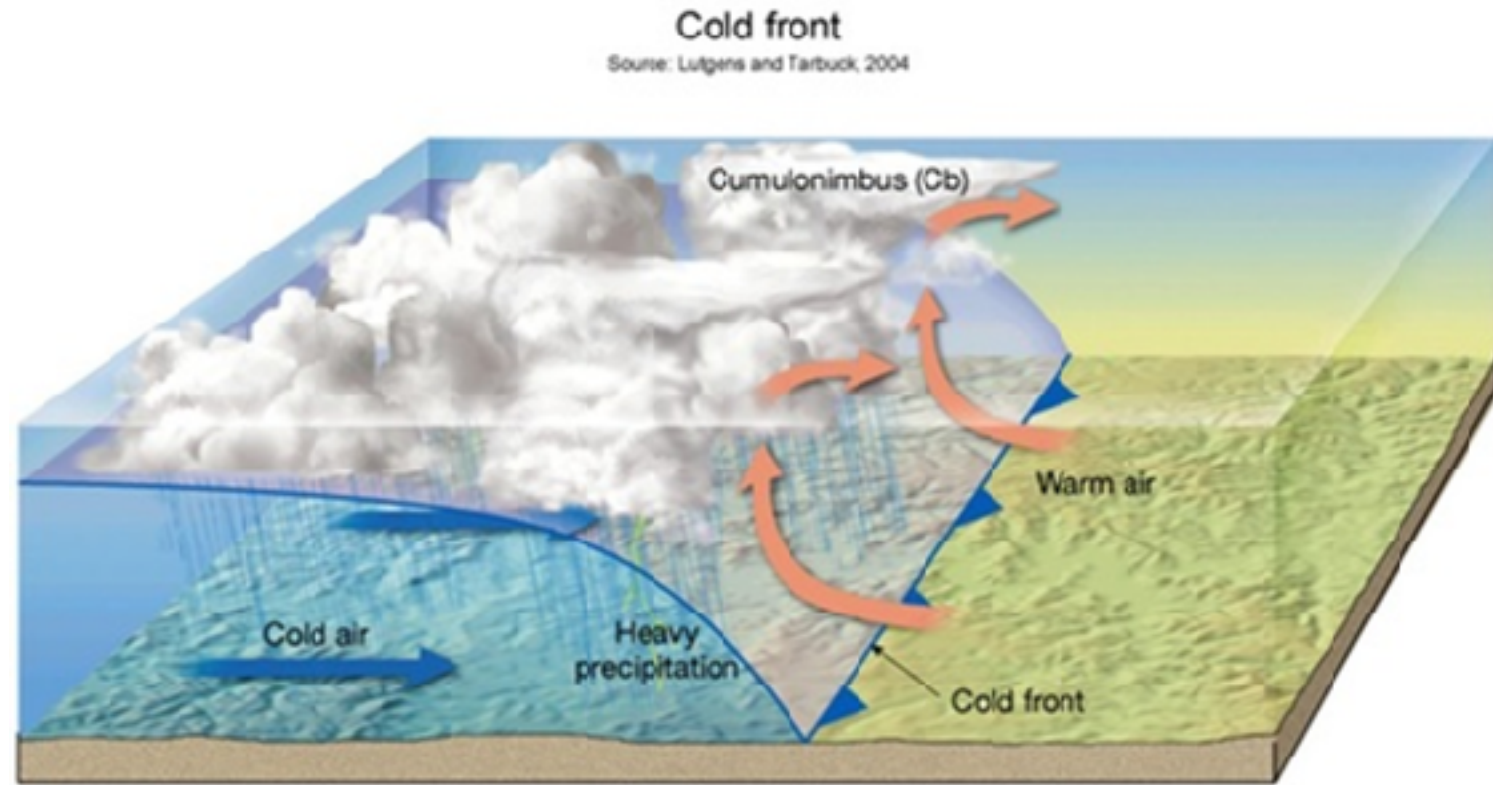
Prevailing Westerlies (major wind belts of North America) generally move air West to East

Jet Streams (embedded in prevailing westerlies) bands of high speed winds about 10 km above Earth's surface

Fronts (the boundary where air masses meet) storms and changeable weather are produced where air masses collide

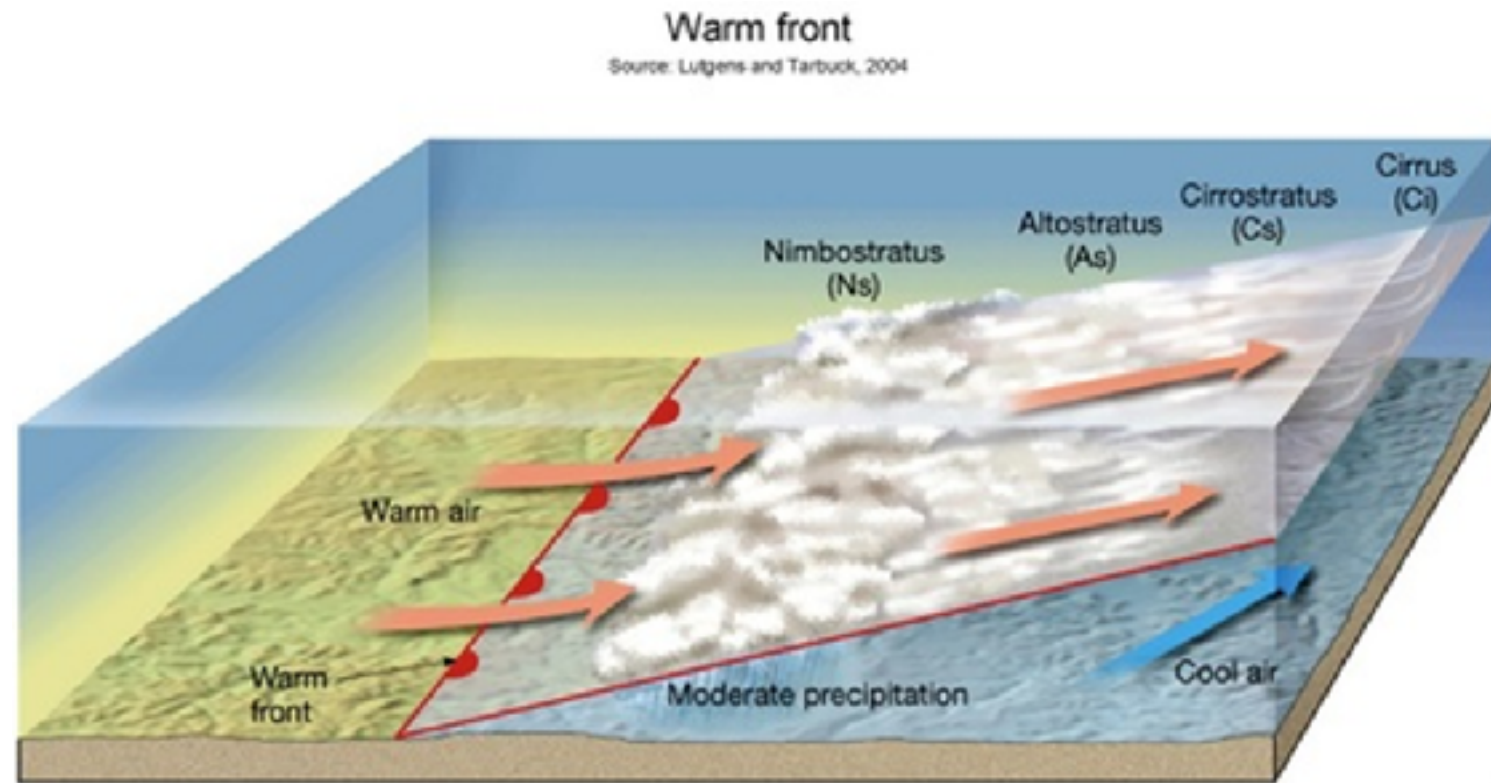
How Air Masses Move – COLD FRONT

- Cold air sinks
- Warm air rises
- Cold air slides under warm air, pushing up moisture and clouds form
- Heavy rain or snow may occur
- Arrive quickly and after they pass they bring clear skies and a shift to a lower temperature



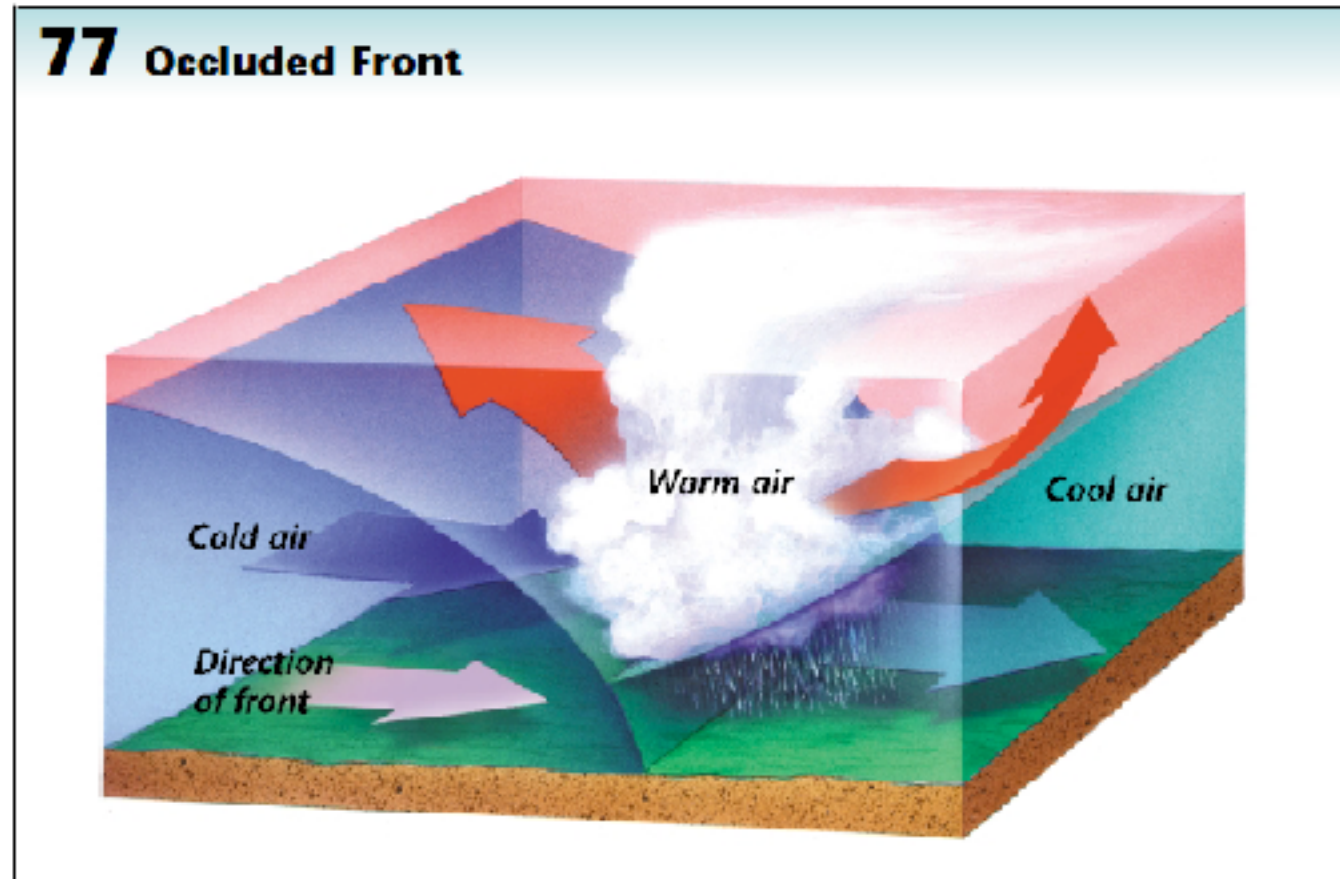
How Air Masses Move – WARM FRONT

- Fast moving warm air takes over the cold slow moving air
- If warm air is humid - precipitation might occur, if dry scattered clouds form
- May stay rainy or cloudy for several days
- After it passes weather tends to be warm and humid.



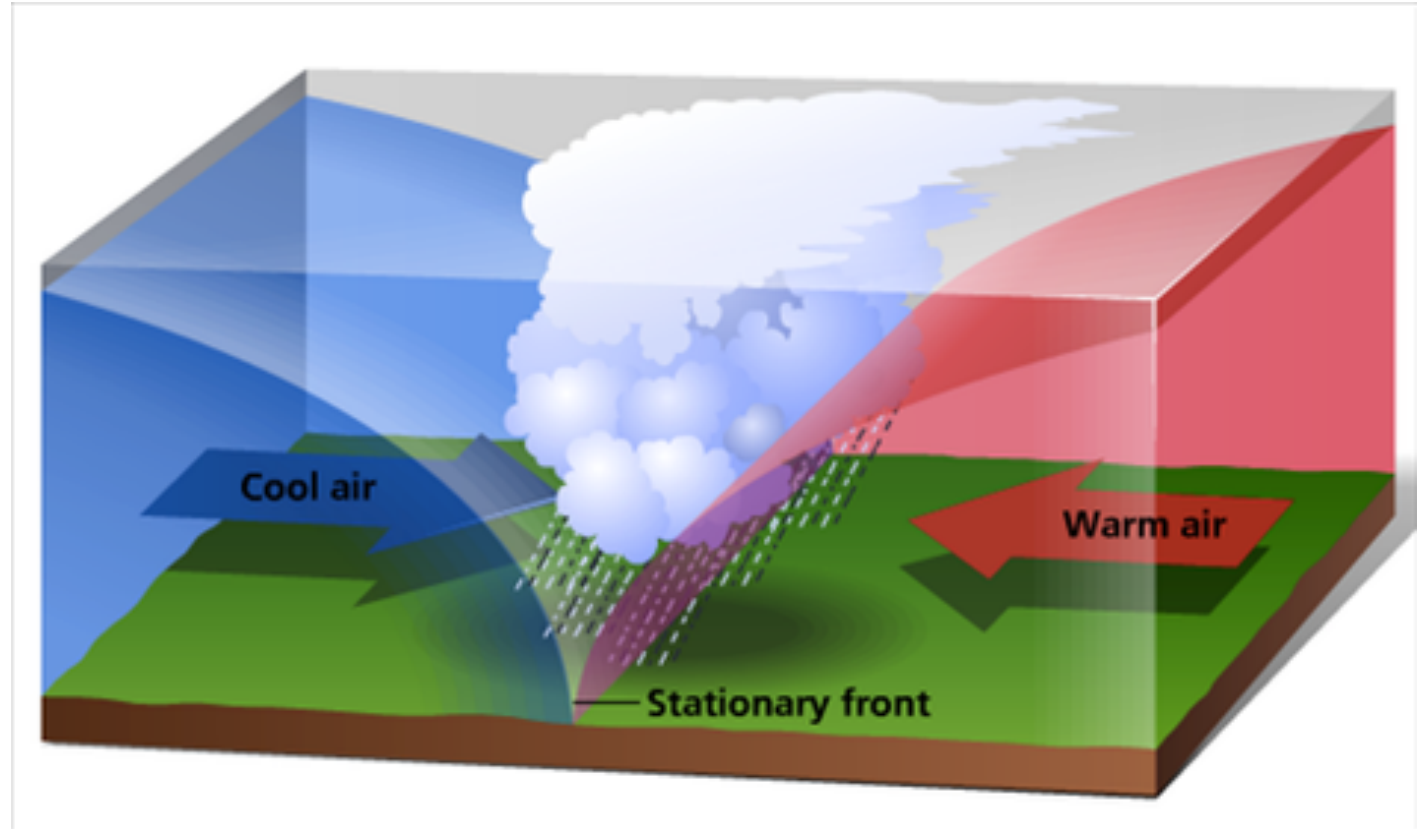
How Air Masses Move – Occluded Front

- Most complex
- Warm air trapped between 2 cold air masses
- The 2 cold fronts meet and mix, pushing warm air up and cutting it off (or occluded)
- If warm air cools it may produce precipitation



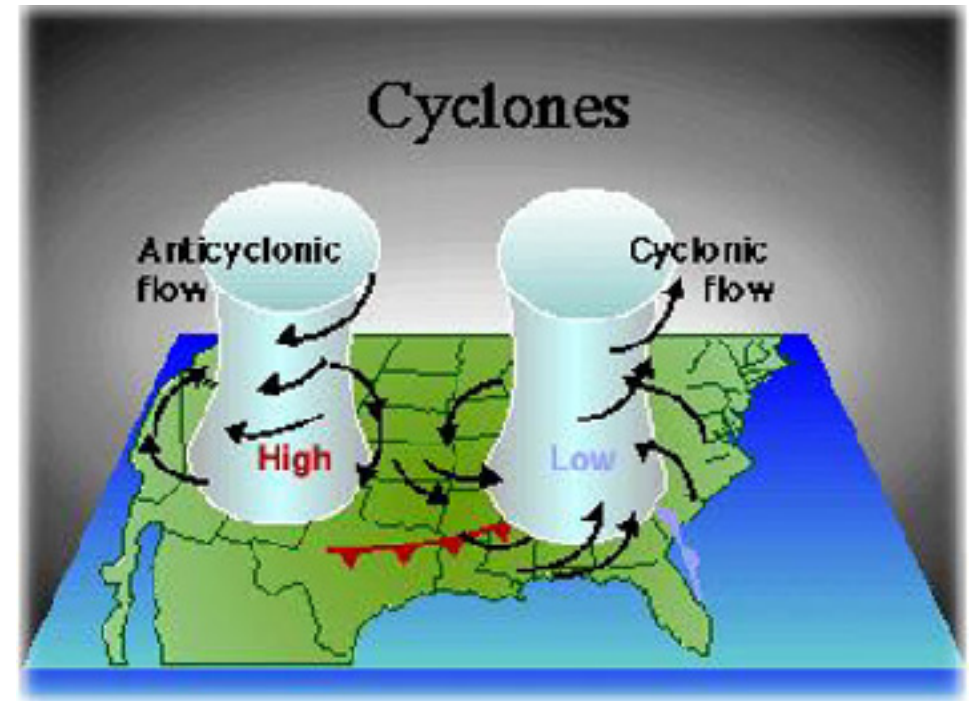
How Air Masses Move- Stationary Front

- When warm and cold air masses collide sometimes they do not move
- Where they meet precipitation may occur
- Many days of clouds or precipitation



Cyclones and Anticyclones

- On a weather map: L = Low pressure area H = High pressure area
- **Cyclone**: a swirling zone of LOW air pressure
- Cyclones and decreasing air pressure are associated with clouds, winds and precipitation
- **Anticyclones**: HIGH pressure centers of air
- The descending air in an anticyclone generally cause clear, dry weather



Storms

Storm: A violent disturbance in the atmosphere

Winter storm: all year round most precipitation in the air starts as snow. If the air temp. is colder than 0 Celsius all the way to the ground, precipitation falls as snow

Thunderstorm: form in large cumulonimbus clouds known as thunderheads

Lightning & thunder:

Lightning: a sudden spark or electrical discharge

Thunder: Sound produced from the heat from a lightning bolt as it superheats the surrounding air, causing it to explosively expand

Storms

Hurricane: a tropical cyclone with winds of 199 km/hr or higher and can reach 600 km across in size

Hurricanes begin over warm ocean water as a low pressure area, warm air rises and forms clouds, winds spiral inward toward area of low pressure



Tropical disturbance → Tropical storm → Hurricane

As hurricanes meet the shoreline: high waves and flooding

Storm surge: a “dome” of water that sweeps along the coast where hurricane lands

Category	Wind Speed (mph)	Damage at Landfall	Storm Surge (feet)
1	74-95	Minimal	4-5
2	96-110	Moderate	6-8
3	111-130	Extensive	9-12
4	131-155	Extreme	13-18
5	> 155	Catastrophic	19+

Storms

Tornado - a rapidly whirling, funnel shaped cloud that reaches down from a thunderstorm to touch Earth's surface

- Over water: called a waterspout
- Typically form in cumulonimbus clouds (same as thunderstorms)
- Most often in spring & early summer in late afternoon when ground is warm



Ranked on Enhanced Fujita scale by how much damage

Light damage= EF 0

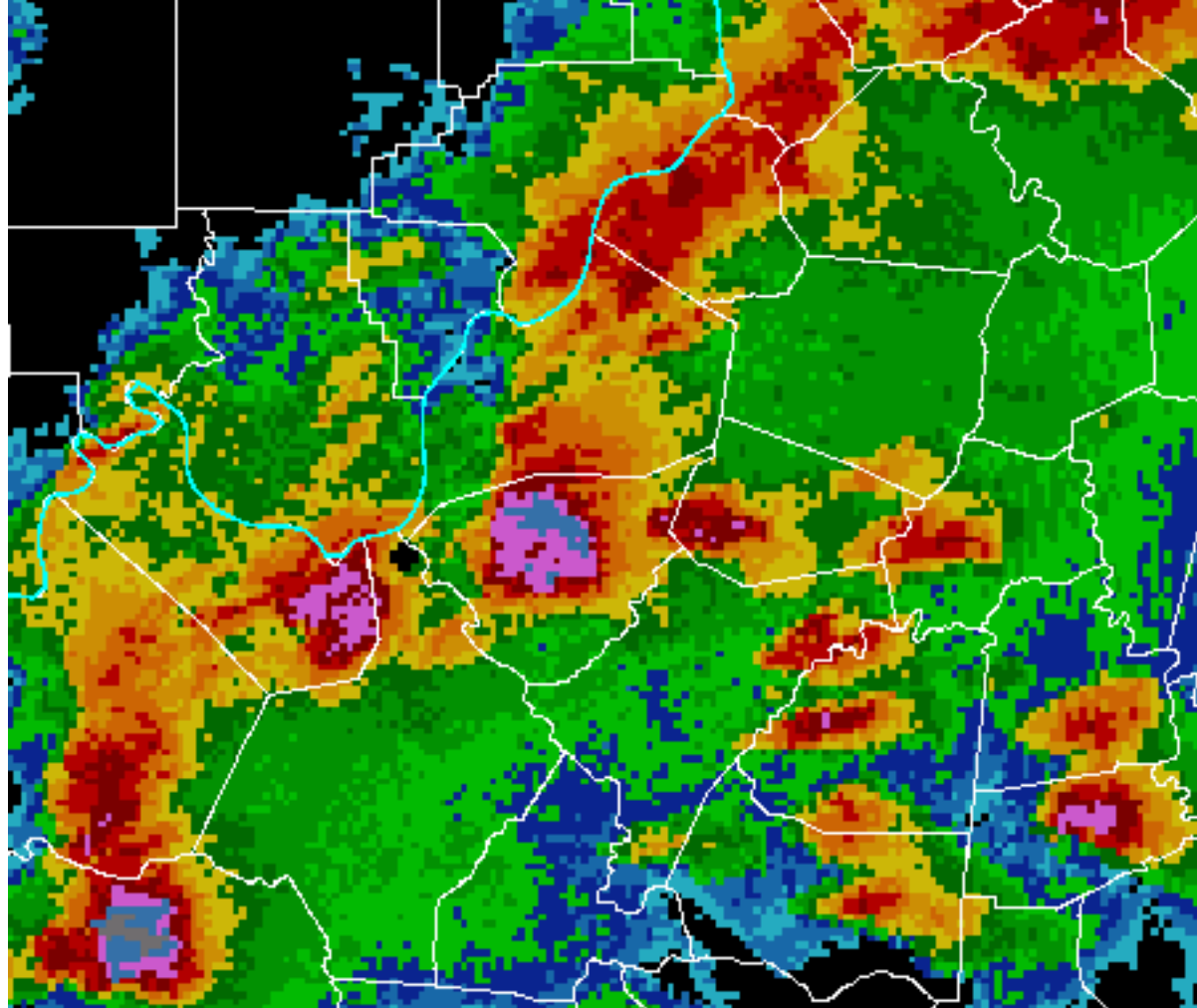
Extreme damage = EF 5

Lesson 3 - Weather Forecasts

Surface report - set of weather measurements at the Earth's surface by HUMAN OBSERVERS

Upper-air report - weather measurements taken by a radiosonde
- instruments carried up by a weather balloon

Satellite and radar (Doppler - can detect precipitation)
images 35,000 km above the surface



Predicting Weather

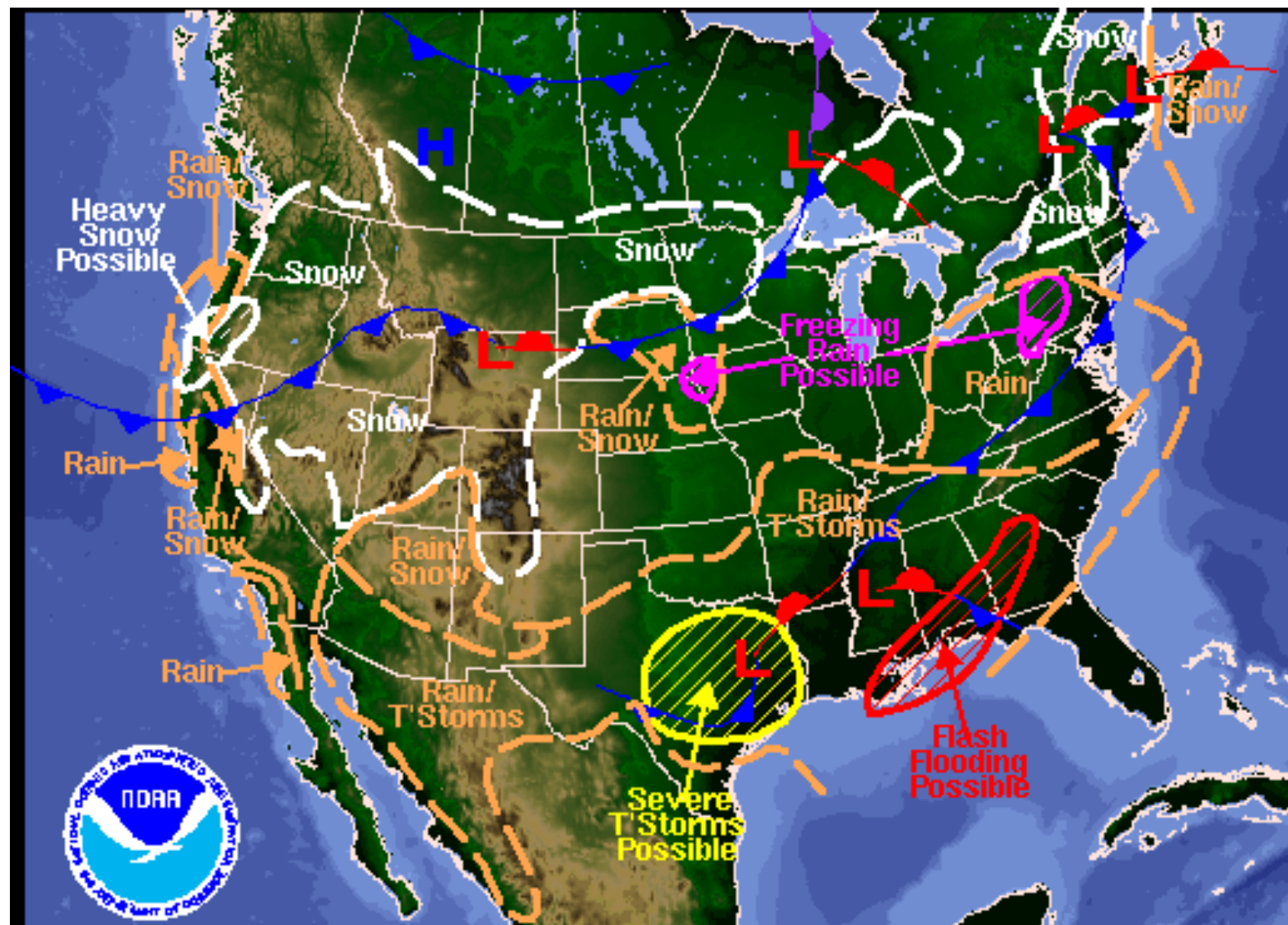
- Meteorologists use maps, charts, computers and other technology to analyze weather data to prepare weather forecasts.

- Technology:

- Weather satellites
- Weather balloons
- Automated weather stations
- Computer forecasts



- While technology helps make more accurate forecasts, especially for short term weather, but predicting long term weather is still more difficult

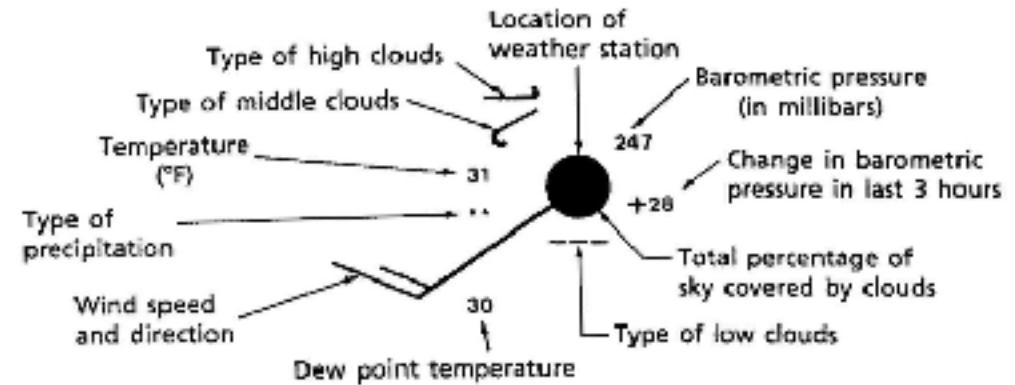


Weather Forecast for Sun, Jan 01, 2017, issued 4:27 AM EST
DOC/NOAA/NWS/NCEP/Weather Prediction Center
Prepared by Tate based on WPC, SPC and NHC forecasts

Weather Maps

- Data from all over the country are gathered into maps.
- **Isobars**: lines that join places on a map of equal (“iso-”) air pressure (-”bar” or weight)
- **Isotherms**: lines that join places on a map of equal temperature

Weather Map Symbols (Simplified Version)



SYMBOLS USED IN PLOTTING REPORT

Precipitation	Wind speed and direction	Sky coverage	Some types of high clouds
≡ Fog	○ 0 calm	○ No cover	→ Scattered cirrus
• Snow	↗ 1–2 knots	⊙ 1/10 or less	→ Dense cirrus in patches
• Rain	↘ 3–7 knots	◐ 2/10 to 3/10	→ Veil of cirrus covering entire sky
⚡ Thunderstorm	↘ 8–12 knots	◑ 4/10	→ Cirrus not covering entire sky
⋈ Drizzle	↘ 13–17 knots	◒ ½	
▽ Showers	↘ 18–22 knots	◓ 6/10	
	↘ 23–27 knots	◔ 7/10	
	↘ 48–52 knots	◕ Overcast with openings	
	1 knot = 1.852 km/h	◖ Complete overcast	

Some types of middle clouds	Some types of low clouds	Fronts and pressure systems
↗ Thin altostratus layer	⌒ Cumulus of fair weather	(H) or High Center of high or low pressure system
↘ Thick altostratus layer	⌒ Stratocumulus	⚡ Cold front
↗ Thin altostratus in patches	--- Fractocumulus of bad weather	⚡ Warm front
↘ Thin altostratus in bands	— Stratus of fair weather	⚡ Occluded front
		⚡ Stationary front