



CIVIL AIR PATROL

United States Air Force Auxiliary
Maxwell Air Force Base, Alabama

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Aerospace Dimensions

AIR ENVIRONMENT

MODULE 3

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Chapter 3 - Moisture and Clouds

After completing of this chapter, you should be able to:

- Describe the condensation process.
- Describe how saturation occurs.
- Define dew point.
- Define what precipitation is and give some examples.
- Define fog.
- Define turbulence.



Important Terms - Moisture and Clouds

- **condensation** - the process of converting water vapor to liquid.
- **dew point** - the temperature at which the air becomes saturated.
- **fog** - tiny droplets of liquid water in contact with the surface
- **precipitation** - general term given to various types of condensed water vapor.
- **saturation** - a parcel of air is holding as much water vapor as it can.
- **relative humidity** - amount of water vapor in the air compared to its water vapor capacity at a given temperature.

Moisture and Clouds

- Moisture
 - Moisture is Water in Solid (Ice), Liquid (Water), or Gaseous (Vapor) form
 - The air can only hold a limited amount of water vapor, when it contains the maximum amount, it is Saturated
 - Saturation depends on temperature, the temperature at which the air WILL become saturated is called the Dew Point
 - Add more moisture, or decrease the temperature BELOW the Dew Point, and Condensation (conversion to liquid) occurs
 - Clouds and Fog are both forms of Condensation
 - Humidity describes the amount of moisture in the air
 - The normal measure is Relative Humidity, which is the % of saturation which has been reached, e.g. 70%
- Fog - mass of water droplets in suspension (Ground Level Cloud)
 - Occurs when Temp & Dew Point are within 5° and wind is low

Moisture and Clouds

- Clouds

- Like Fog, Clouds are a mass of water droplets in suspension, but they can also contain ice crystals, or water / ice mixed
- There are 3 basic Cloud Forms:
 - Cumulus - White, Billowy, Puffy (Cotton Balls), Low Level
 - Normally seen in good weather, but also associated with turbulence
 - Stratus - Thin, Sheet like, Grey, Low Level
 - Cirrus - White, Thin, Wispy, High Level

- Precipitation

- When the temperature fall too far below the Dew Point, and the Cloud can no-longer hold the moisture in suspension, Precipitation Results
 - Either Rain, Snow or Ice (hail) depending on temperature
 - Precipitation is measured with a Rain Gauge
 - Precipitation reduces Visibility, and makes runways slippery
 - Ice increases Aircraft weight, and can block inlets

Cloud Formation

- Clouds are a combination of tiny droplets of water or ice crystals clinging to condensation nuclei
- Condensation nuclei are tiny particles of salt, soot and dust.
- There are three basic types of clouds: Cumulus, Stratus, and Cirrus

Cumulus Clouds



Cumulus Clouds



Stratus Clouds



Cirrus Clouds



Lenticular Clouds



FOG





Chapter 4 - Weather Systems and Changes

After completing this chapter, you should be able to:

- Define an air mass and identify air mass characteristics.
- Define a front and describe the types of fronts.
- Describe hurricanes, thunderstorms, and tornadoes.
- Identify the stages of a thunderstorm.
- Outline safety precautions for thunderstorms and tornadoes.



Important Terms - Weather Systems and Changes

- **air mass** - huge body of air with the same temperature and moisture characteristics.
- **front** - a boundary between two air masses.
- **hurricane** - a tropical cyclone of low pressure and very strong winds; usually heavy rain with possible thunderstorms and tornadoes.
- **thunderstorm** - cumulonimbus cloud possessing thunder and lightning; usually strong winds, rain and sometimes hail.
- **tornado** - whirling funnel of air of very low pressure and very strong winds; can suck up anything in its path and must touch the ground to be called a tornado.

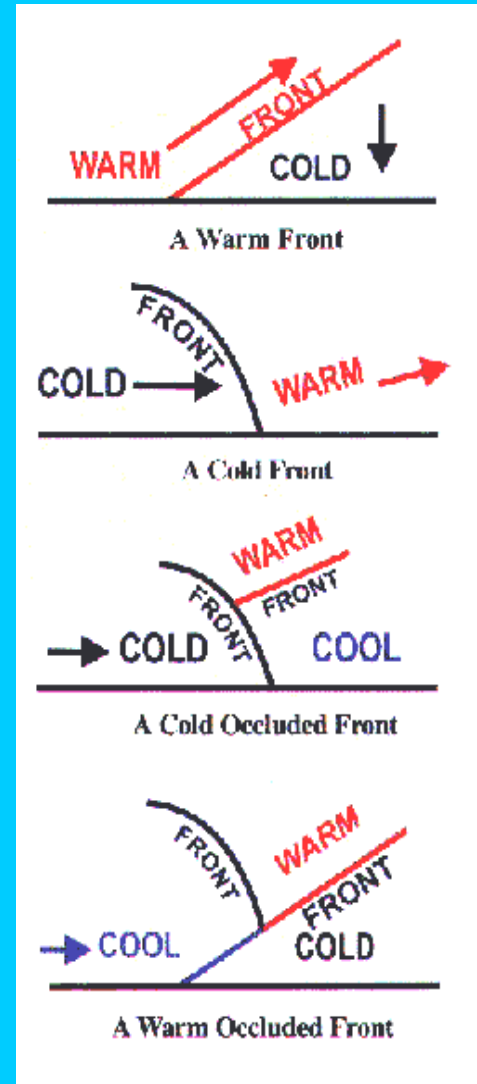
Weather Systems and Changes

- **Air Masses** - A HUGE mass of air
 - Normally at least 1000 miles across
 - Essentially the same Temperature and Moisture characteristics throughout
 - Air masses are classified by where they came from, i.e. their Source Region
 - The 6 Source Regions are:
 - cA - continental Arctic
 - cP - continental Polar
 - cT - continental Tropical
 - mT - maritime Tropical
 - mP - maritime Polar
 - mE - maritime Equatorial
 - Maritime masses are wetter
 - Farther away from the equator = a colder mass

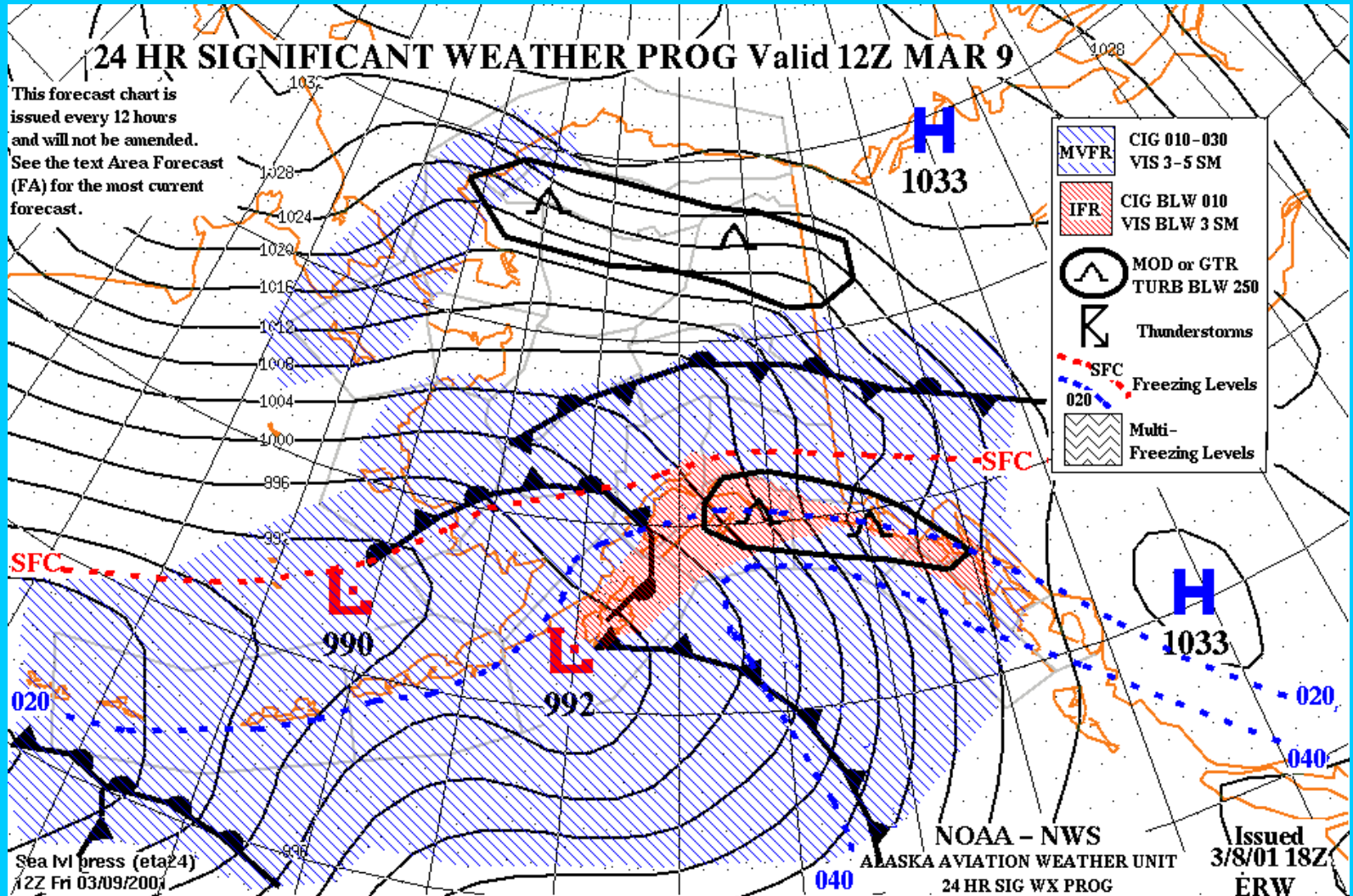
Weather Systems and Changes



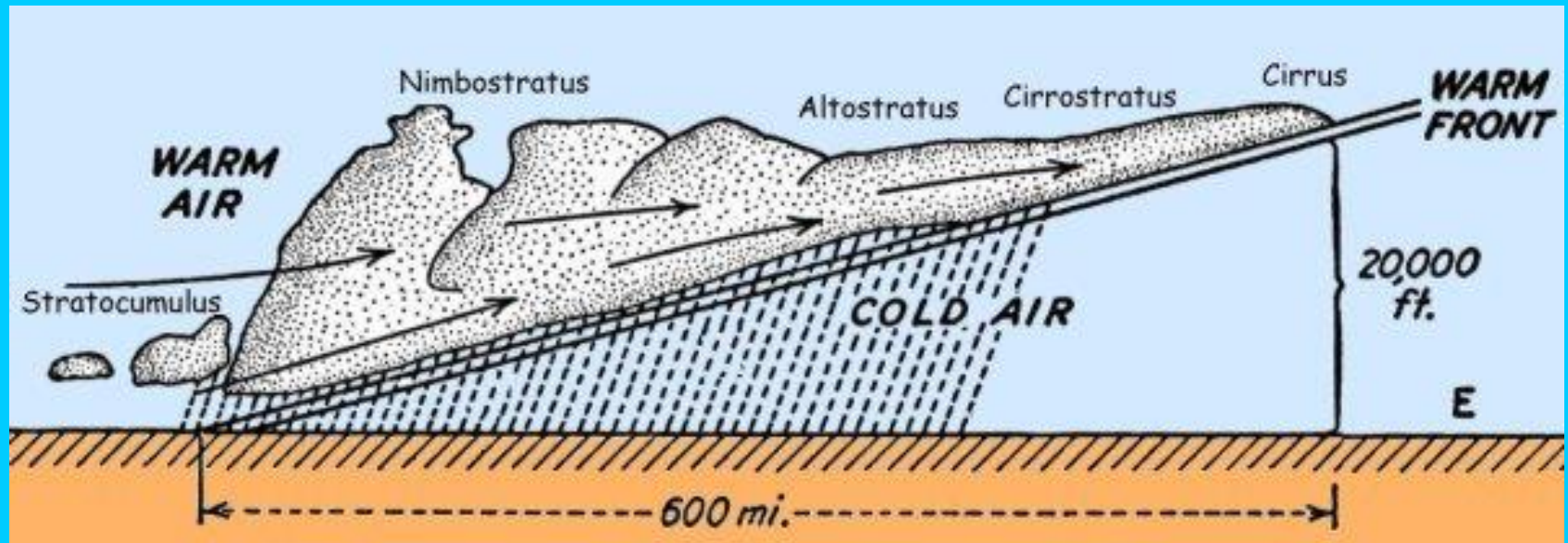
- **Fronts** - the boundary between 2 air masses:
 - WARM Fronts ride up over Cold Air
 - Normally COLD Fronts are heavy and low, and push Warm Fronts up, and away
 - When similar air masses meet, there may not be enough difference to cause movement, and a STATIONARY Front occurs
 - An OCCLUDED Front (3 air masses) the Warm air is still pushed up, but relatively cool air is pushed up also by colder air
 - Cold Occluded - Old Cool Air pushed up, basically like a Cold Air snowplough, pushing everything Upwards
 - Warm Occluded - New Cool Air pushed up behind Warm Air, by local colder air



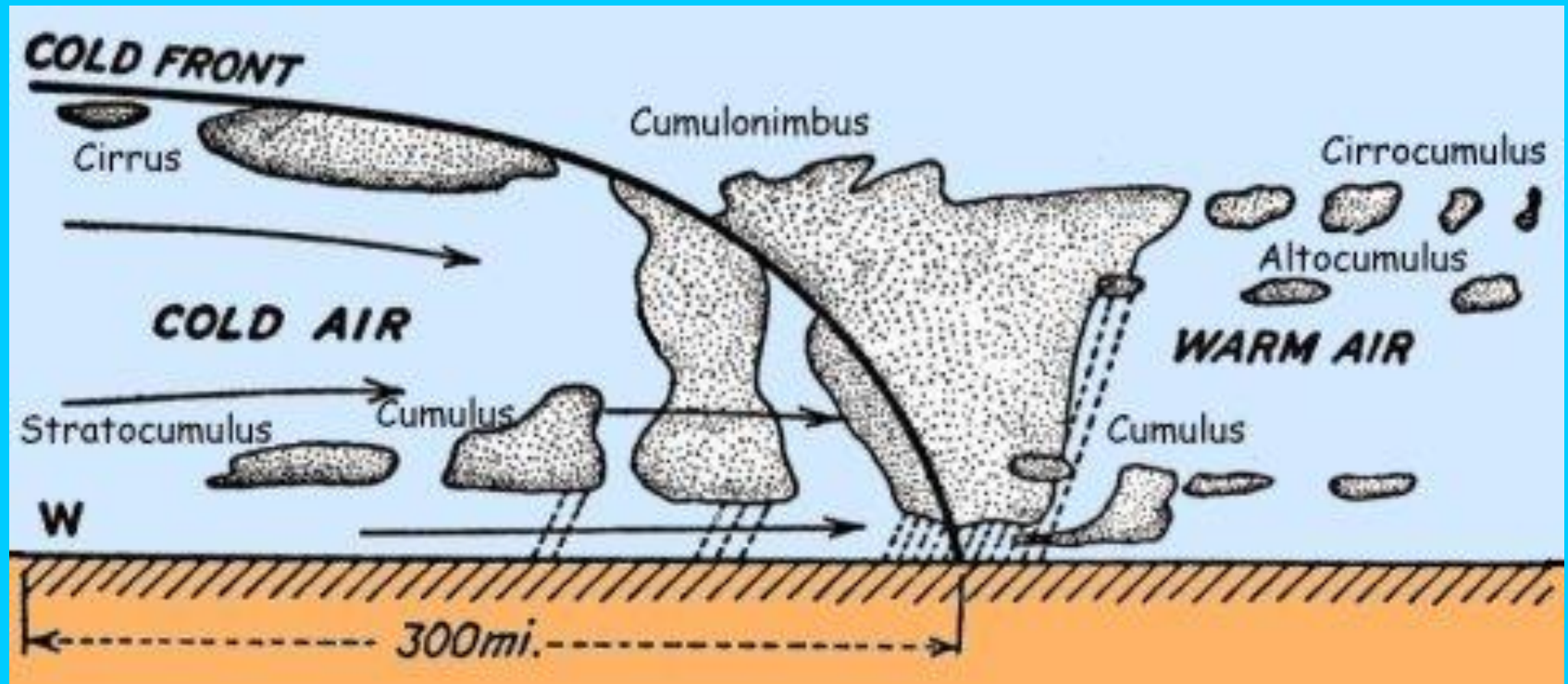
FRONTS



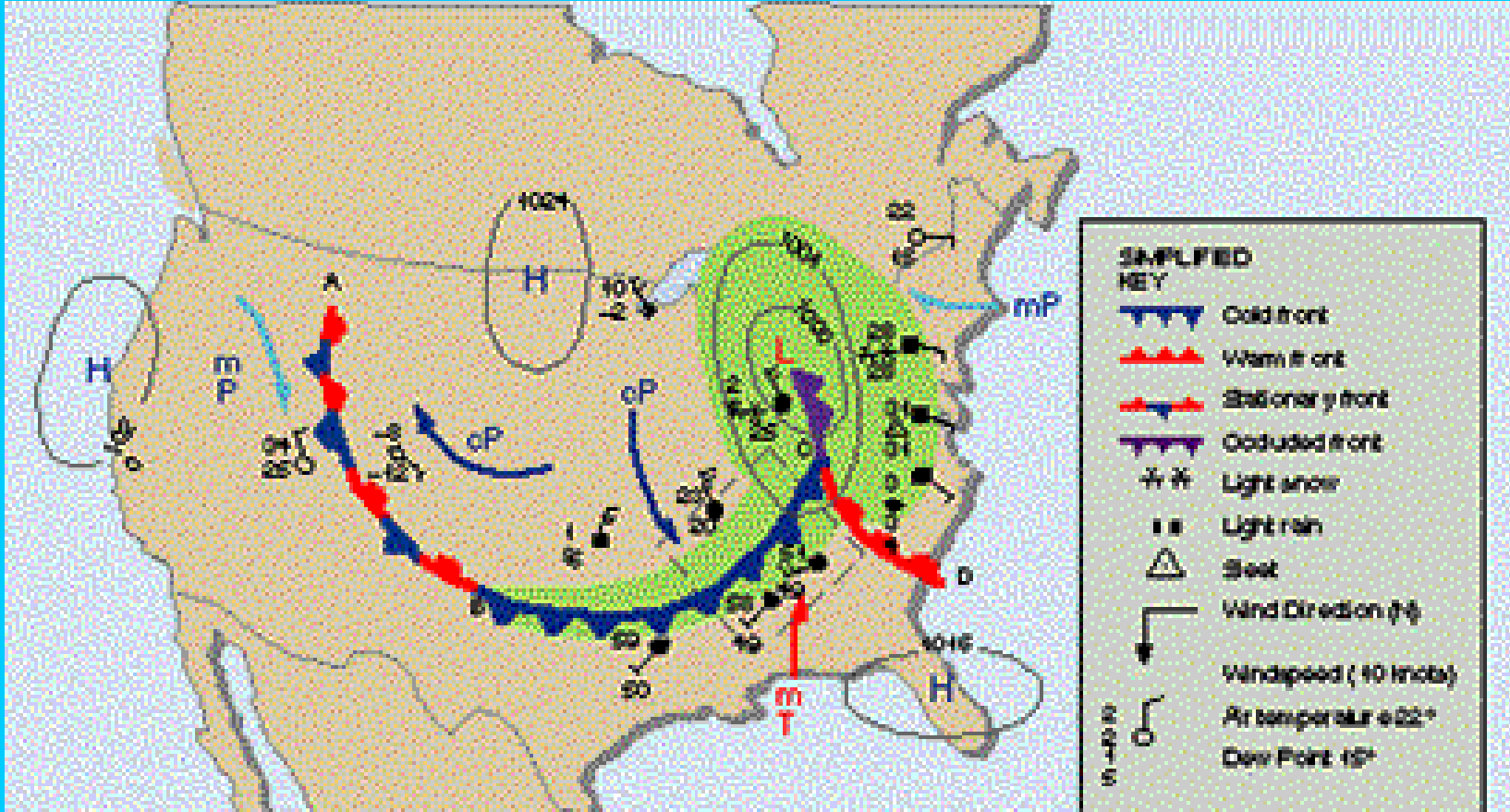
WARM FRONTS



COLD FRONTS



OCCLUDED FRONTS



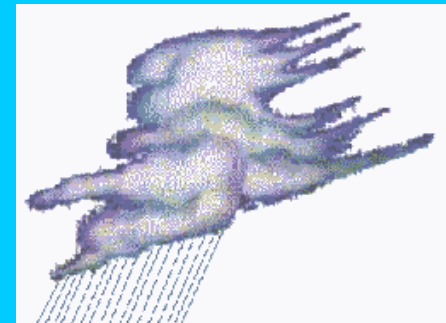
Weather Systems and Changes

- Severe Weather

- **Cumulonimbus** clouds are a sign of Severe Weather, which could be a Thunderstorm, Tornado or Hurricane
- **Thunderstorms**



- Heavy Winds, Strong Rain, Sometimes Hail
- Lightning - Electric Discharge, which can heat the air to 60,000°F!
 - About 200 are killed and 600 injured by lightning in the US annually!
 - 3 stages: Building (Updrafts), Mature (Up/Down air cycles), Dissipating (Downdrafts)
- Do's and Don'ts:
 - Don't use electric appliances, telephones, or take a shower
 - DO Stay away from Windows and Doors
 - If Outdoors, DO go Inside
 - If in a car, DO stay there
 - If in a boat, DO get ashore
 - DO Move away from Water and Metal objects
 - Don't stand in open space, or under a tree
 - DO Stay Low, and Don't huddle in a group



Cumulonimbus



Lightning



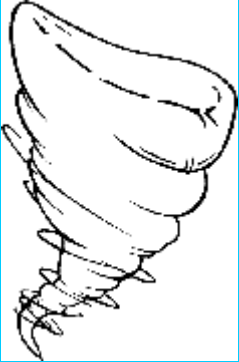
HAIL



Weather Systems and Changes

– Tornadoes

- Fujita Wind Damage Scale - F0 to F5, with wind speed range and expected scale of damage for each



- *F5 is over 261 MPH, with 'Incredible' Damage resulting*
- *Do's and Don'ts:*
 - » *DO Get to a Basement (or lie down in low ground)*
 - » *DO, If above ground, move at 90° to the Tornado*
 - » *DO, if indoors, stay away from windows, got to the interior, or into a closet or bathroom*

– Hurricanes

- Saffir-Simpson Hurricane Damage Potential Scale -
Cat 1 (75-95 MPH), to Cat 5 (155+ MPH!), with Pressure Range,
Wind Speeds, and Storm Surge (Sea Level increase)

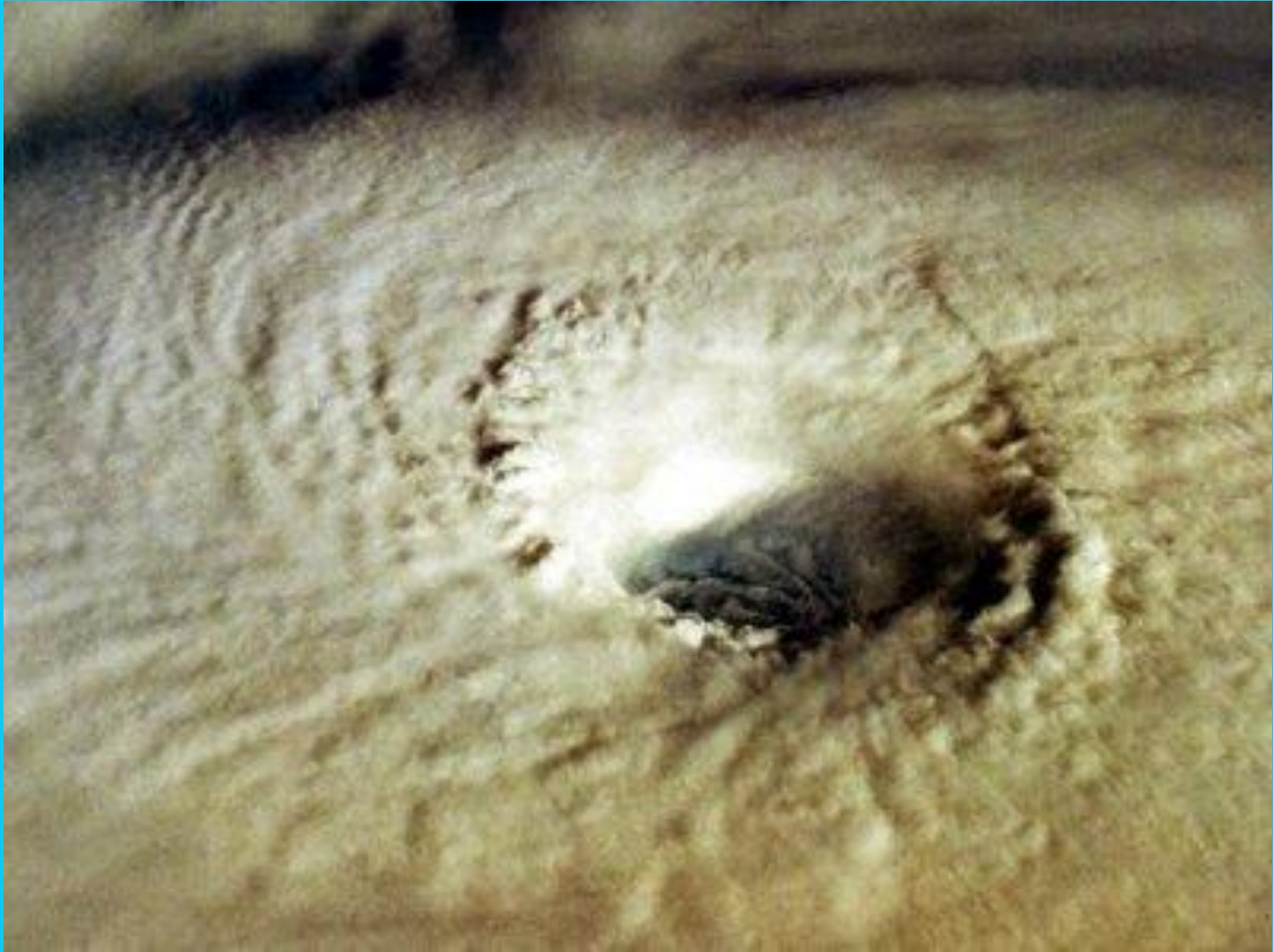


- *Do's and Don'ts:*
- *same as Thunderstorms & Tornadoes, since they can produce BOTH*
- *Worse, they can be HUGE, and can continue for more than a week!*
- *But, Hurricanes have a 'Eye' at the center which is calm*

Funnel Cloud



HURRICANES



**BEFORE YOU FLY: CHECK THE WEATHER
AND FILE A FLIGHT PLAN!**



Are there any questions?