Weather for GA Pilots

Part 2

Gary White

18 Sep 2012

Agenda

- Stability
- Change of State
- Humidity – Dewpoint
- Clouds - Types
- Precipitation – Types
- Airmasses – Types
- Fronts - Types

Stability

- Resistance to Motion
- If Air is Lifted and it Tends to Return – **Stable**
- If Lifted and Continues to Rise – **Unstable**
- Atmosphere Has a Lapse Rate – We Call That it's ***Environmental Lapse Rate*** – We Measure it with A Radisonde Balloon
- We Compare to a Saturated or Dry Adiabatic Lapse Rate – next page
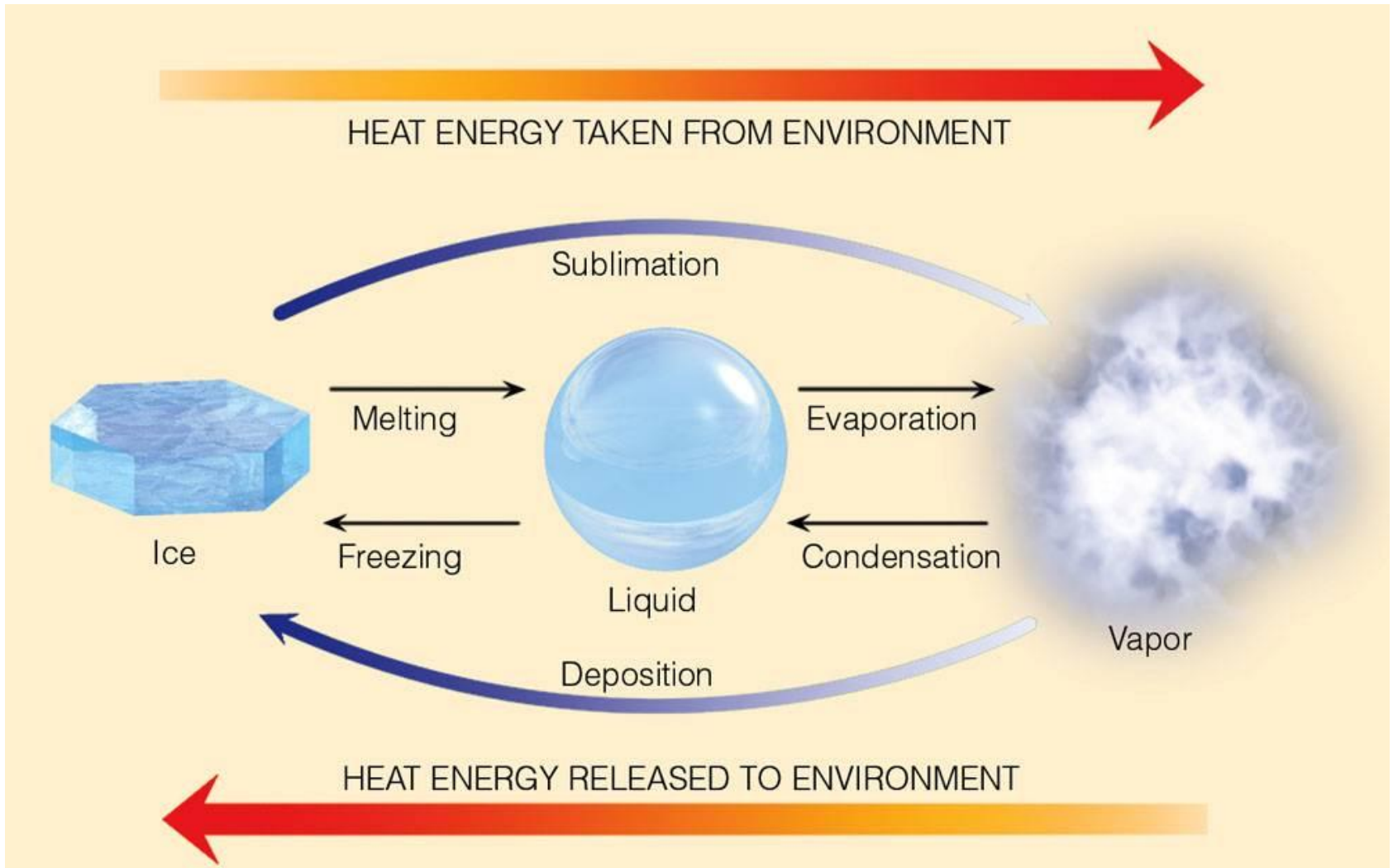
Stability (cont.)
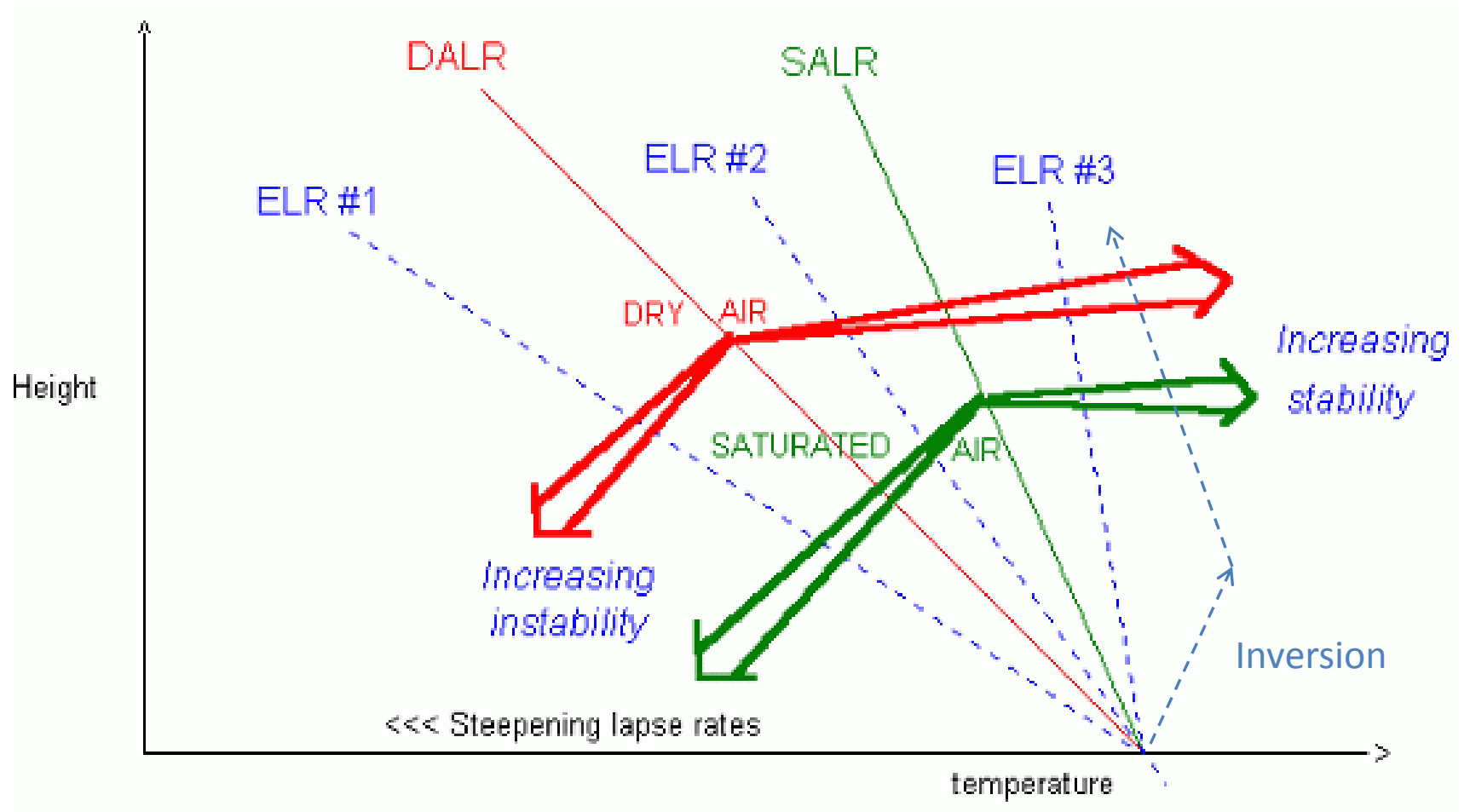
Some Stability Factoids

- Warm Moist Air Tends to Be Unstable
- Warming From Lower Altitude Increases Instability
- The Environmental Lapse Rate (Not Theoretical) Determines Stability
- Smooth, Stable Air is A Feature of an Inversion
    - Visibility is Poor Due to Trapped Pollutants
    - With High Humidity, May Create Inversion Fog
- Inversion Formed by Radiation of Clear Calm Nights – Called Radiation Inversion

Change of State

- State – Liquid, Gas, Solid
- We get Energy from the Sun
- H_2O is the Storage Mechanism
- Heat Transfer Example
  - You Workout and Create Sweat (H_2O)
  - Sweat Evaporates from Liquid to Water Vapor (Gas)
  - You Feel Cooler the Evaporation Process Absorbs Some of Your Body Heat

Change of State (cont.)

HEAT ENERGY TAKEN FROM ENVIRONMENT

Sublimation

Ice Melting Liquid Evaporation Vapor

Freezing Condensation

Deposition

HEAT ENERGY RELEASED TO ENVIRONMENT

© 2007 Thomson Higher Education

Humidity - Dewpoint

- Don't Confuse the Two
- Humidity – Percentage of Water That Can Be Held at a Given Pressure and Temperature
- Dewpoint – Measure of What Temperature Needs to be for a Parcel of Air to Be Saturated
  - More Meaningful to Stability and Cloud Formation
  - Estimate Conditions for Carburetor Icing
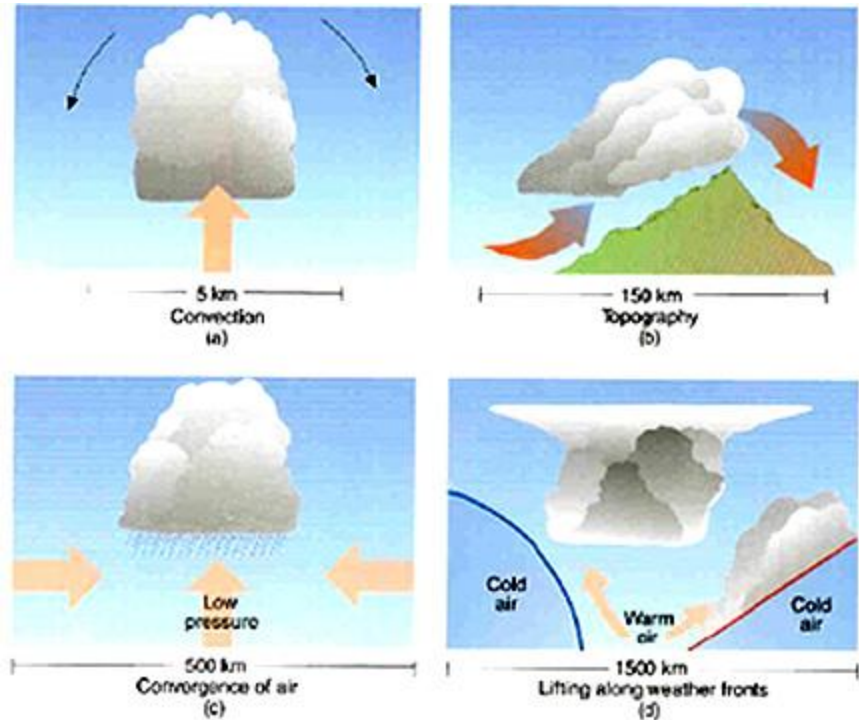 - Formation of Fog and Frost

Dewpoint (cont.)

- As Air Temperature, Dewpoint Difference Becomes Less (Dewpoint Spread), Likely
  - Fog, Especially Early Morning Radiation Inversion
  - Frost, If Dewpoint Below Freezing
  - Frost on Wings Increases Drag

- Dewpoint Spread Can be Used to Estimate Bases of Clouds

Cloud Height Estimate (k feet) = (Air Temperature(F) – Dewpoint(F)) / 4.5

e.g. T = 55 deg F, DP = 37; thus, 18 / 4.5 = 4 thousand feet

Clouds

- Clouds Form By Condensation of Water Vapor

- Cooling of Unsaturated Air Causes Saturation

- Becomes Small H2O Particles (Liquid or Ice)

5 km
Convection
(a)

150 km
Topography
(b)

Low pressure
500 km
Convergence of air
(c)

Cold air
Warm air
Cold air
1500 km
Lifting along weather fronts
(d)

Clouds (cont.)

- Water Vapor Added to Atmosphere by:
  - Evaporation
  - Sublimation

- Clouds – for you Beatle Fans

  http://www.youtube.com/watch?v=oB1Mfu8Dw6E&feature=player_embedded

Cloud Terminology

- Four Types
  - Low – Stratus, Cumulus, Fog
  - Middle – Altostratus, Altocumulus
  - High – Cirrus
  - Vertical - Towering Cumulus, Cumulonimbus
- Vertical has Turbulence, Lighting, and is Caused by Convective (lifting) of Unstable Air
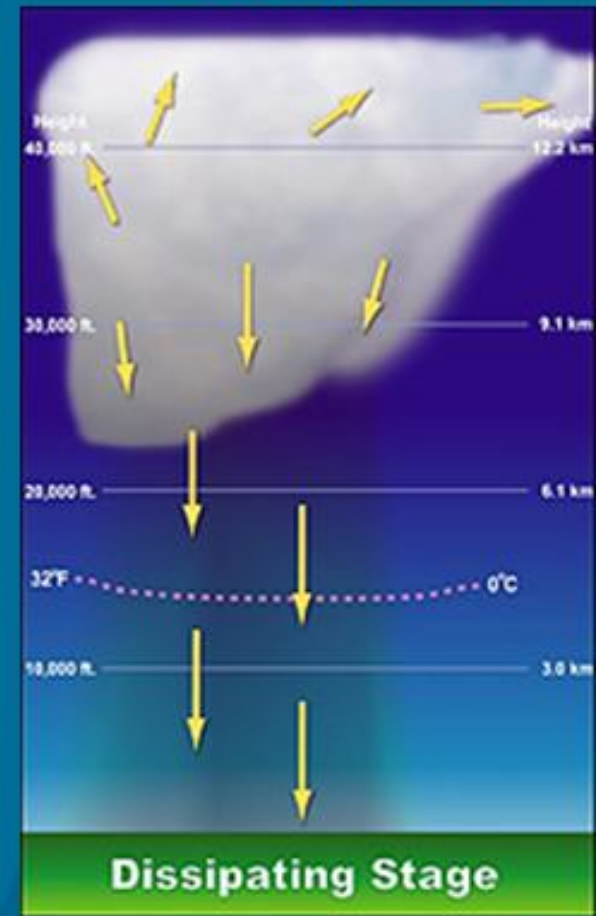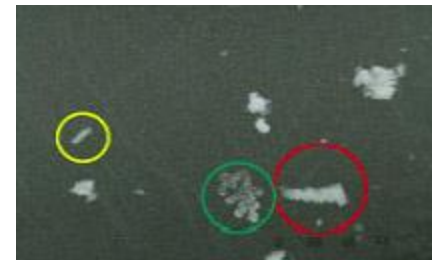
Thunderstorm Stages of Development

Developing Stage

Mature Stage

Dissipating

Dissipating Stage

Precipitation

- Drizzle (DZ) and Mist (BR)
  - Very Small Droplets
  - Associated with Fog or Low Stratus
- Rain (RA) and Showers (SH)
  - Larger Droplets
  - Associated with Cumuliform or Nimbostratus
- Snow (SN)
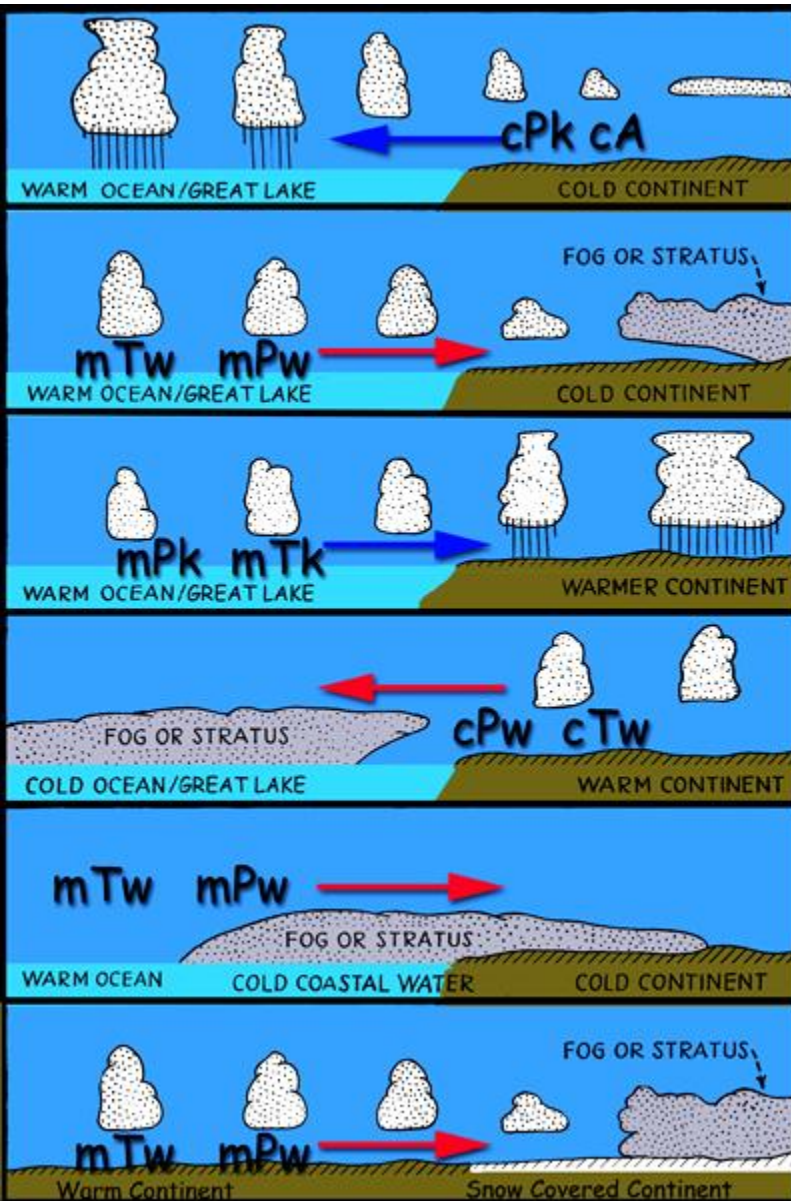 - Formed by Ice Crystals and Process called Accretion

Precipitation (cont.)

- Ice Pellets (PL)
  - Freezing (Super-Cooled Rain) Passes Through Colder Lower Layer (Inversion)
- Hail (GR and GS)
  - Formed by Strong Updrafts
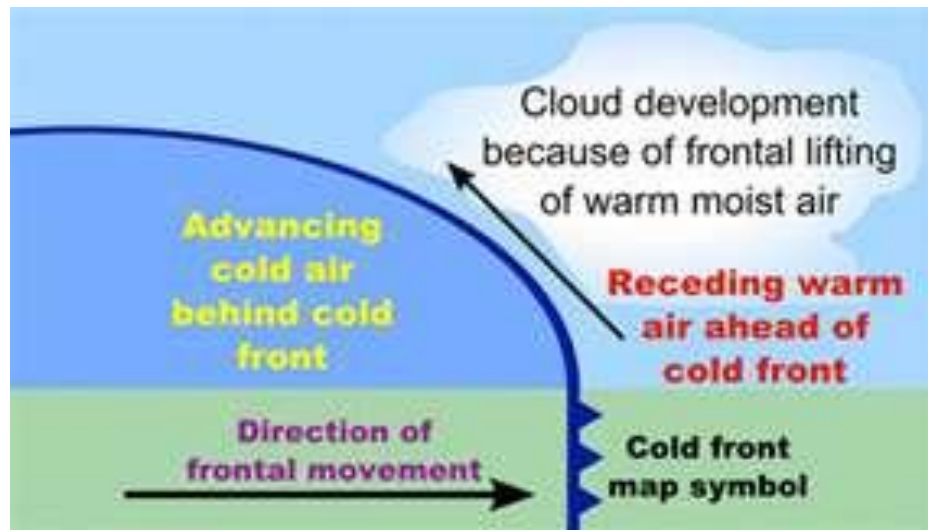 - Accumulated Growth

Airmasses
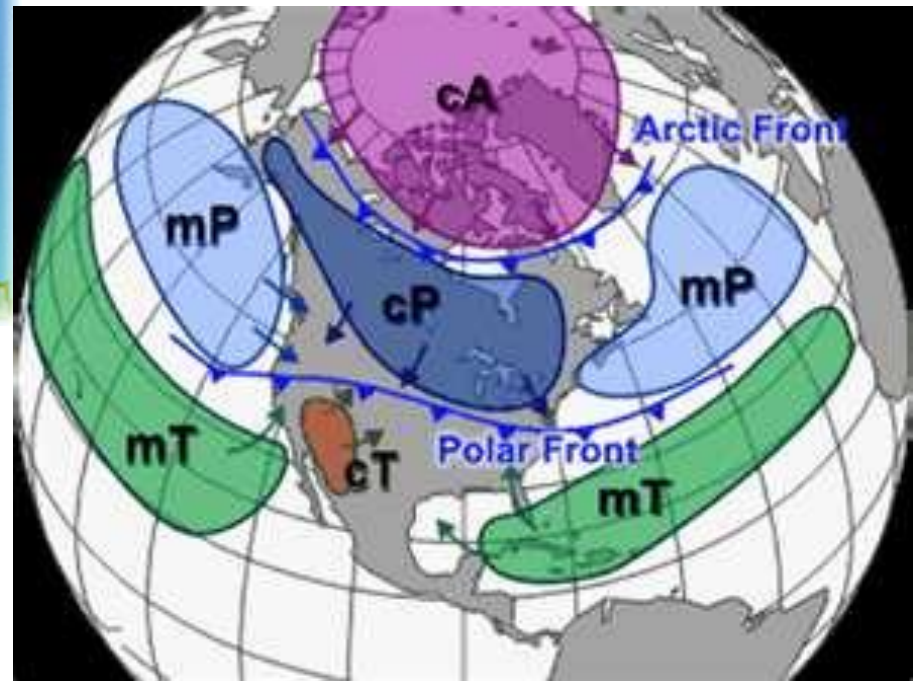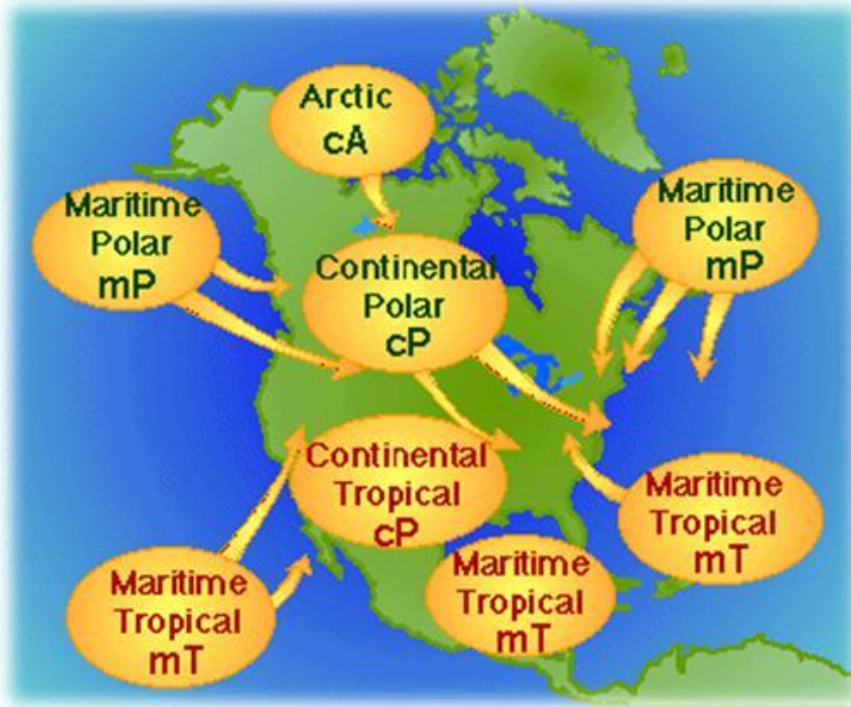
Airmass Modification

- Warming or Cooling from Below
- Addition or Depletion of Moisture
- When Two Different Airmasses Come Together They Create a Front and Associated WX
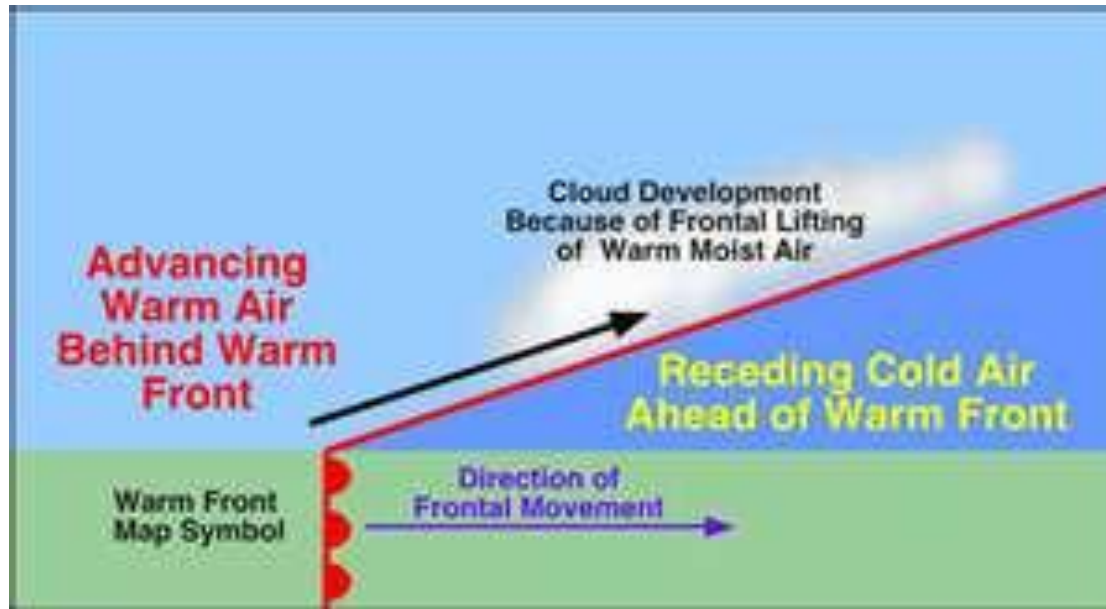- Front is a Boundary Between Airmasses

Fronts

- Frontal Discontinuities
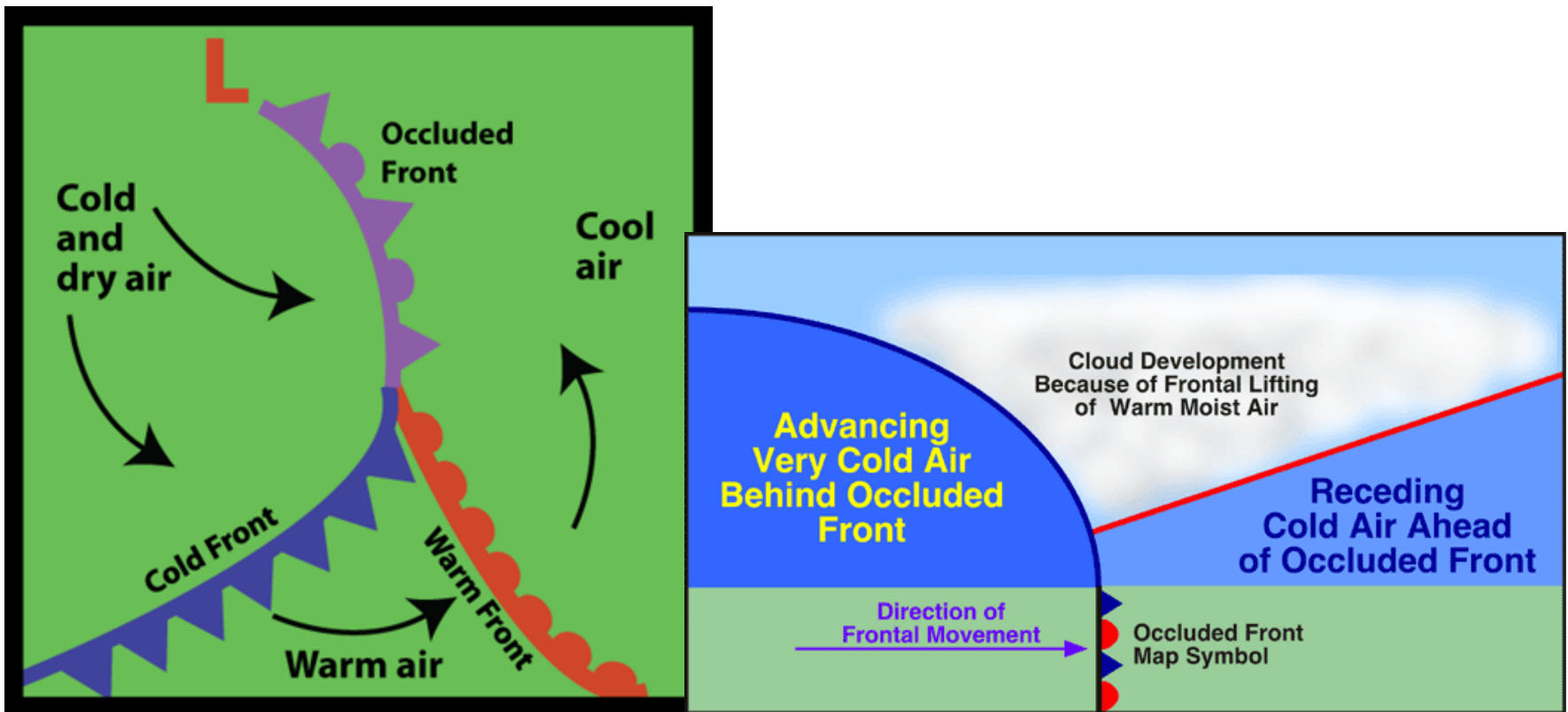 - Temperature
  - Wind
  - Pressure
- Cold Front

Cloud development because of frontal lifting of warm moist air

Advancing cold air behind cold front

Receding warm air ahead of cold front

Direction of frontal movement

Cold front map symbol

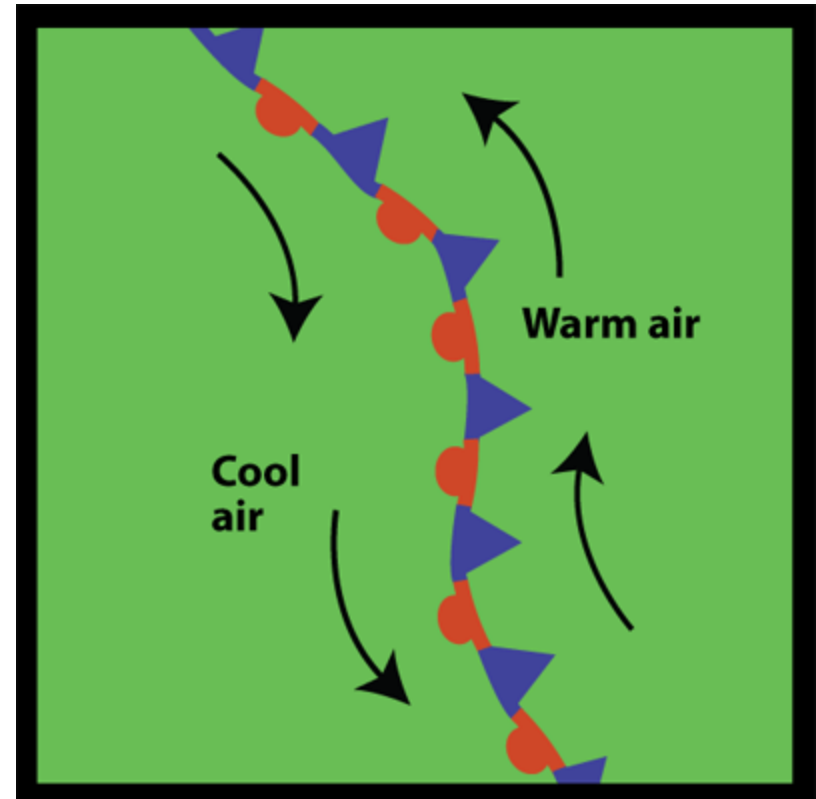# Fronts (cont.)

- Warm Front

Fronts (cont.)

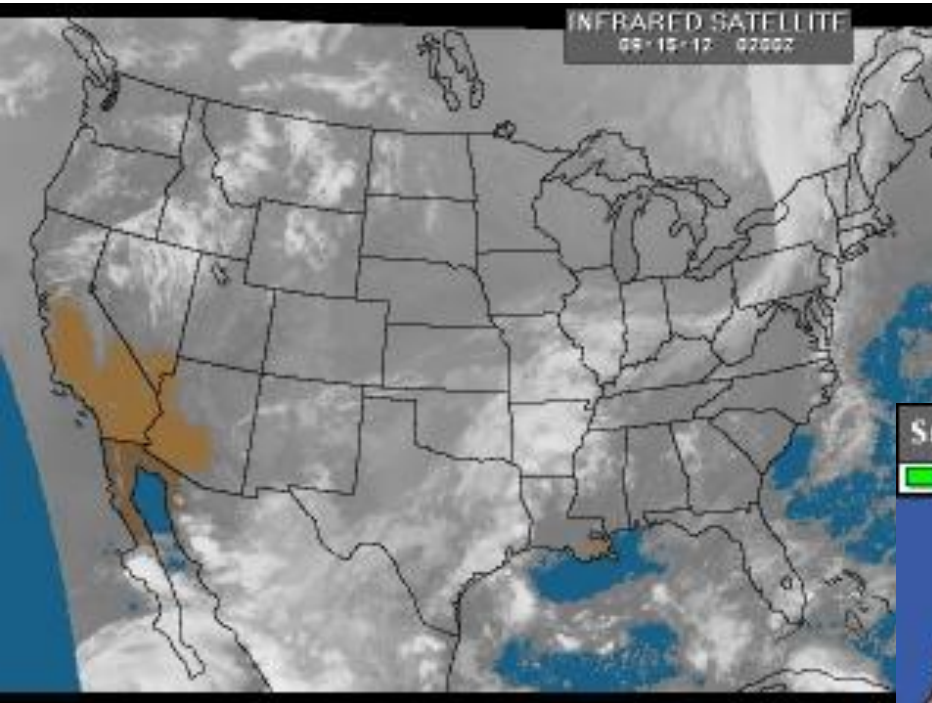- Occluded Front

Fronts (cont.)

- Stationary Front
  - Little Movement
  - May Be Dissipating

Where is the Front - WX?

- IR Satellite
  - White is Cold Upper Air
  - Likely Unstable

- Surface Analysis
  - Not All Fronts Have WX
  - What Kind of WX off SE Coast ?