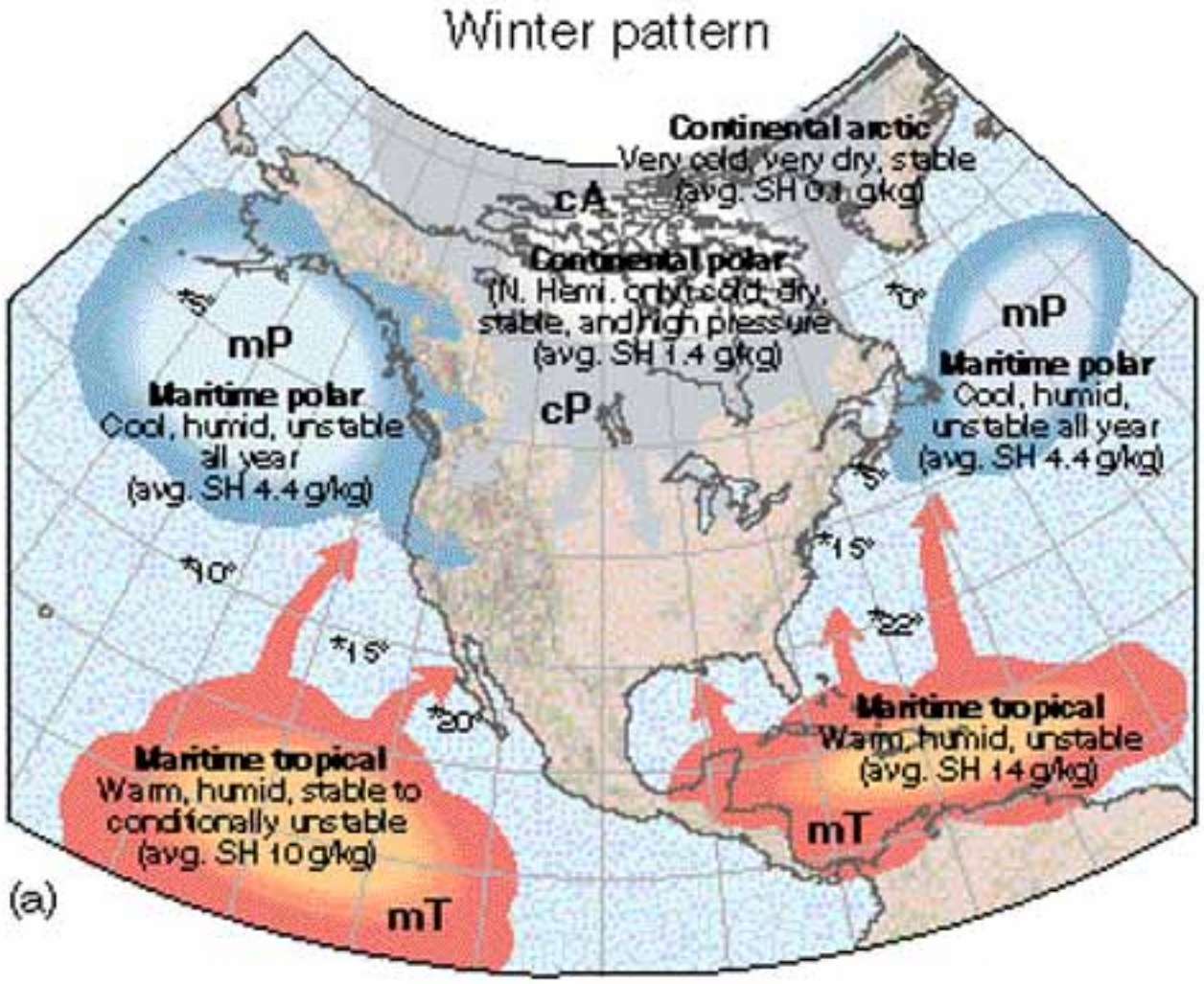
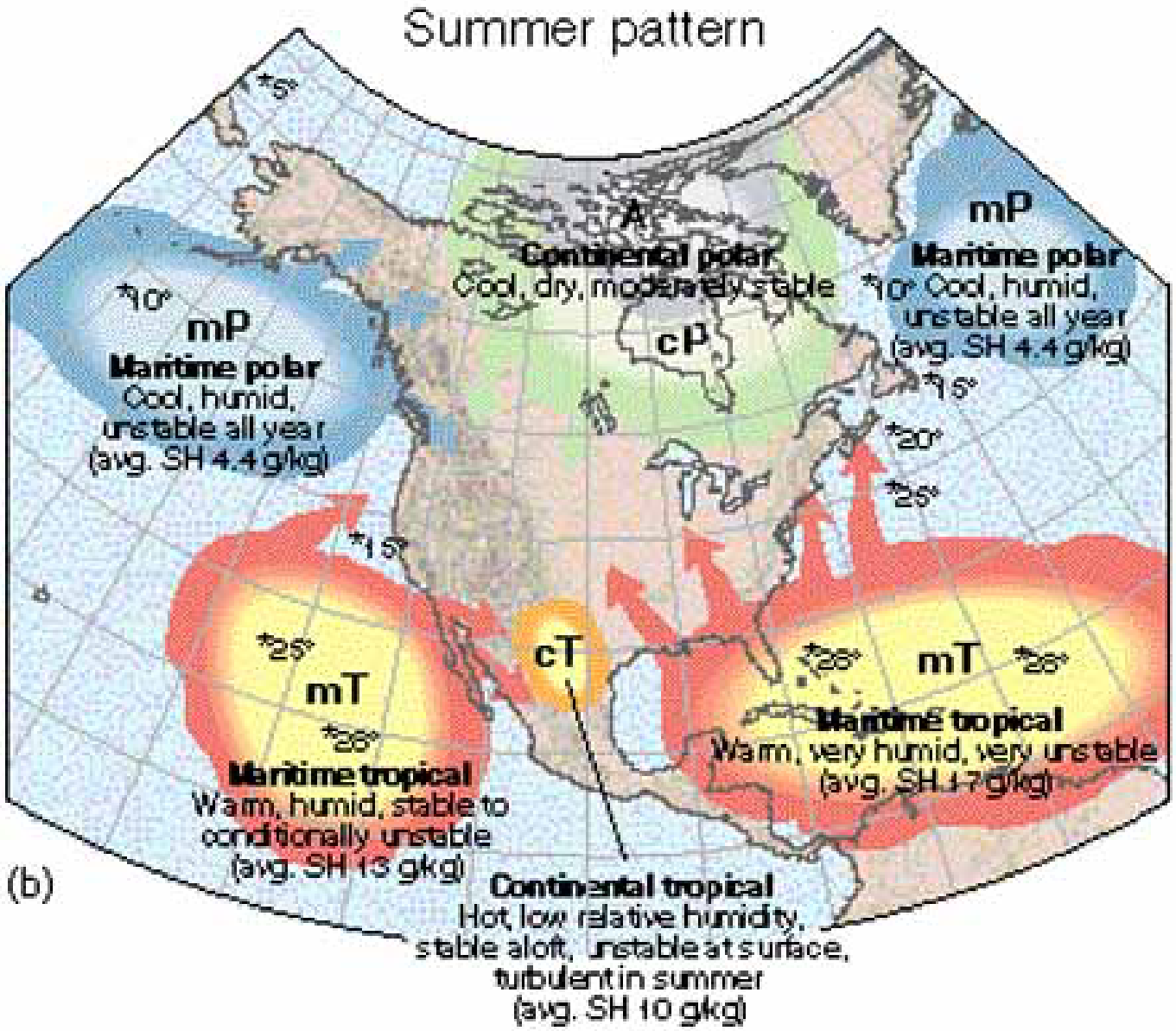
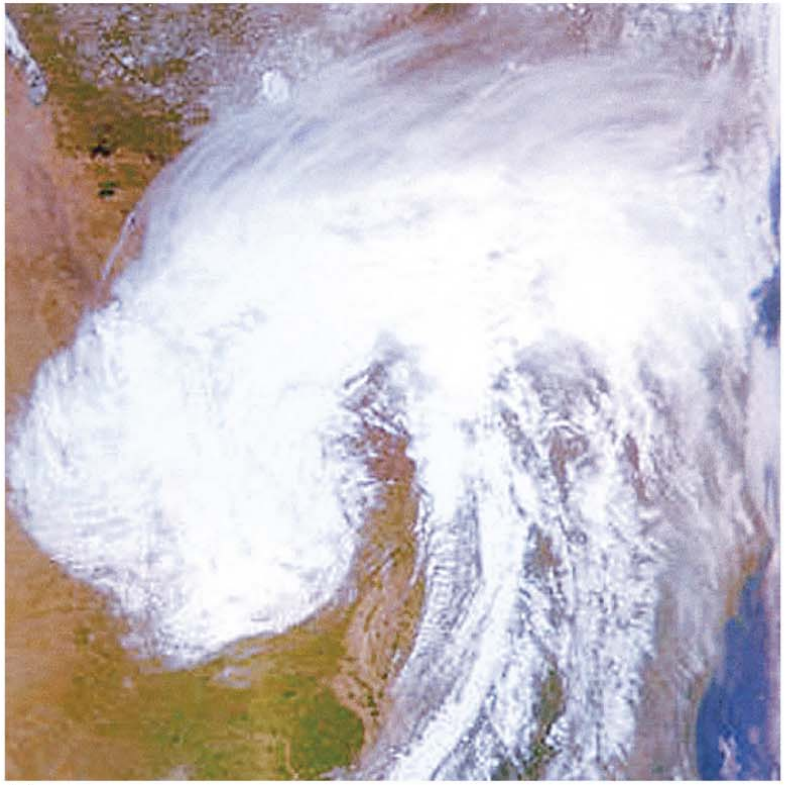
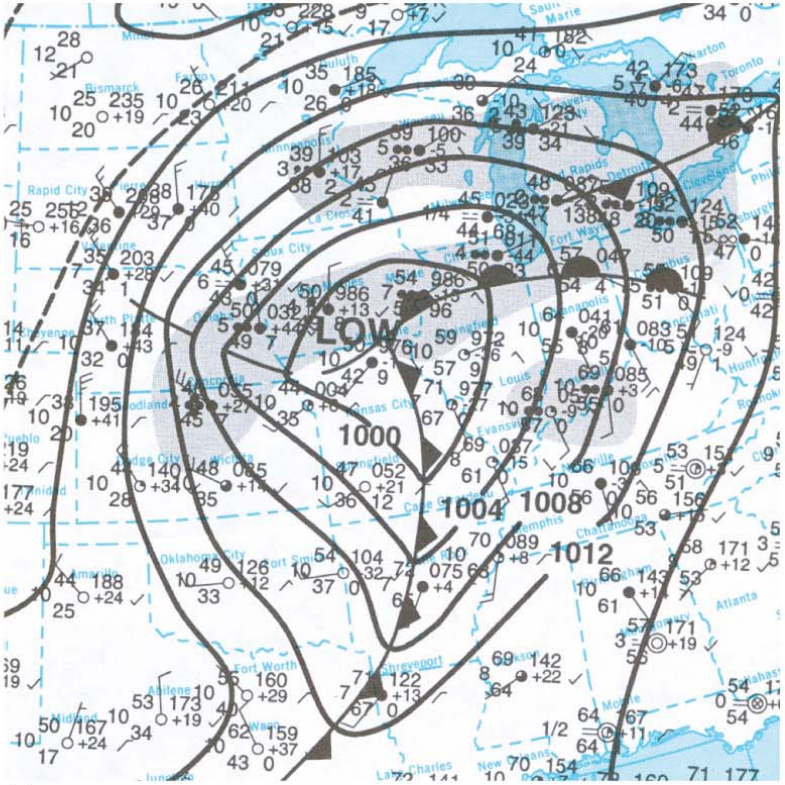

Winter pattern
Continental arctic
Very cold, very dry, stable
(avg. SH 0.1 g/kg)
cA
Continental polar
(N. Hem. only) cold, dry, stable, and high pressure
(avg. SH 1.4 g/kg)
cP
mP
Maritime polar
Cool, humid, unstable all year
(avg. SH 4.4 g/kg)
mP
Maritime polar
Cool, humid, unstable all year
(avg. SH 4.4 g/kg)
Maritime tropical
Warm, humid, stable to conditionally unstable
(avg. SH 10 g/kg)
mT
Maritime tropical
Warm, humid, unstable
(avg. SH 14 g/kg)
mT
(a)


Summer pattern
A
Continental polar
Cool, dry, moderately stable
cP
mP
Maritime polar
Cool, humid,
unstable all year
(avg. SH 4.4 g/kg)
mP
Maritime polar
Cool, humid,
unstable all year
(avg. SH 4.4 g/kg)
*10°
*5°
*15°
*20°
*25°
*15°
*25°
mT
*28°
Maritime tropical
Warm, humid, stable to
conditionally unstable
(avg. SH 13 g/kg)
cT
*28°
mT
*28°
Maritime tropical
Warm, very humid, very unstable
(avg. SH 17 g/kg)
Continental tropical
Hot, low relative humidity,
stable aloft, unstable at surface,
turbulent in summer
(avg. SH 10 g/kg)
(b)

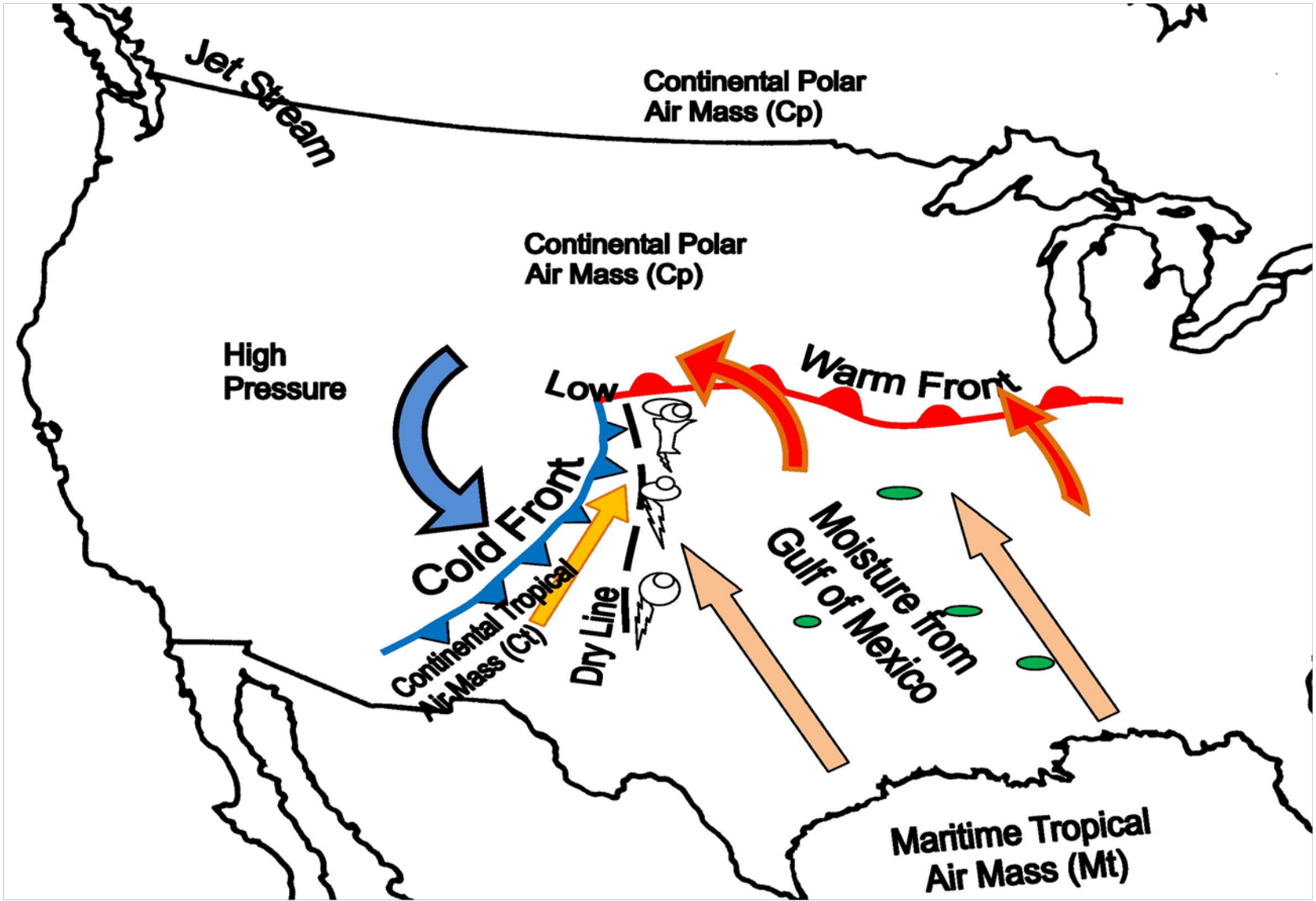


(a)

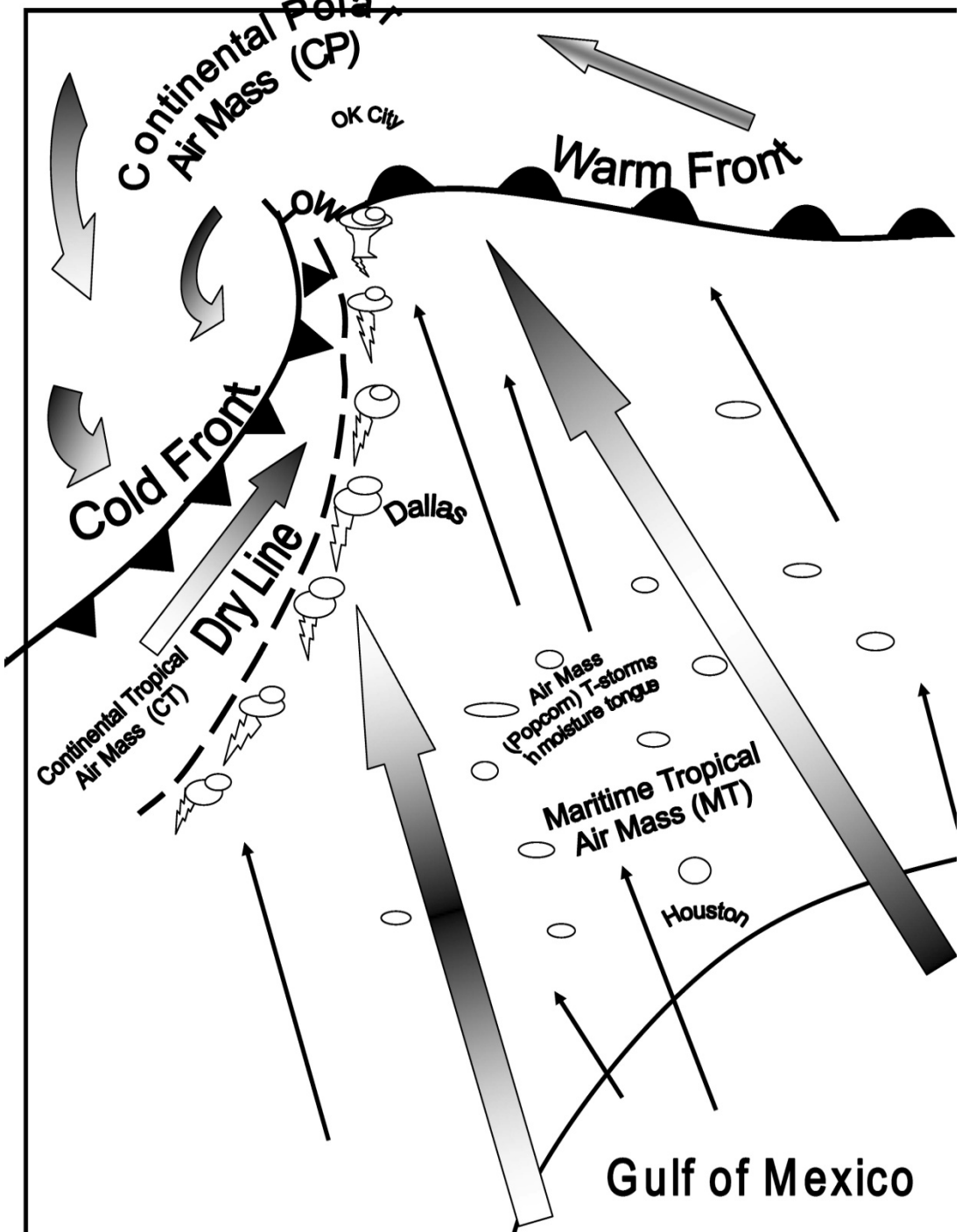


(b)

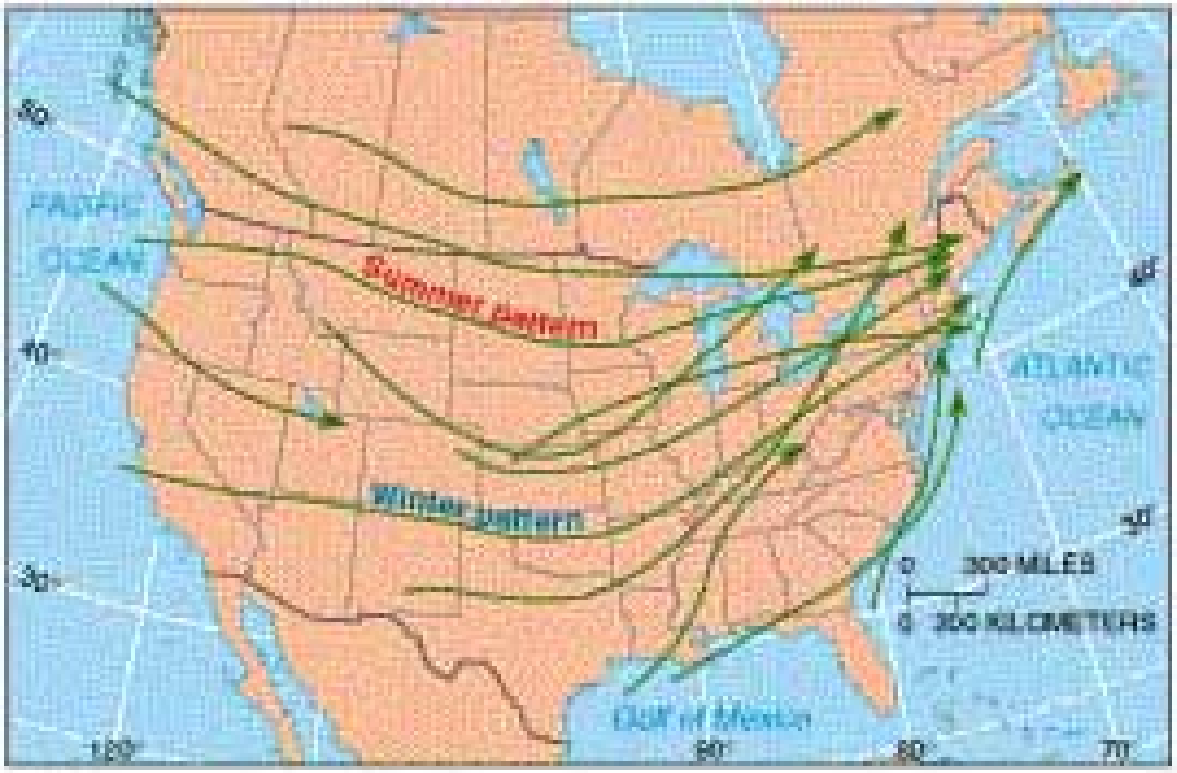
Cyclonic System Operating in the Central U.S. Brings 3 of the 4 Air Masses Together and Can Cause Severe Weather



A Cyclonic System Moving Across Texas and Oklahoma. Tornadoes Often develop in the Strong Thunderstorms just East of the Dry Line



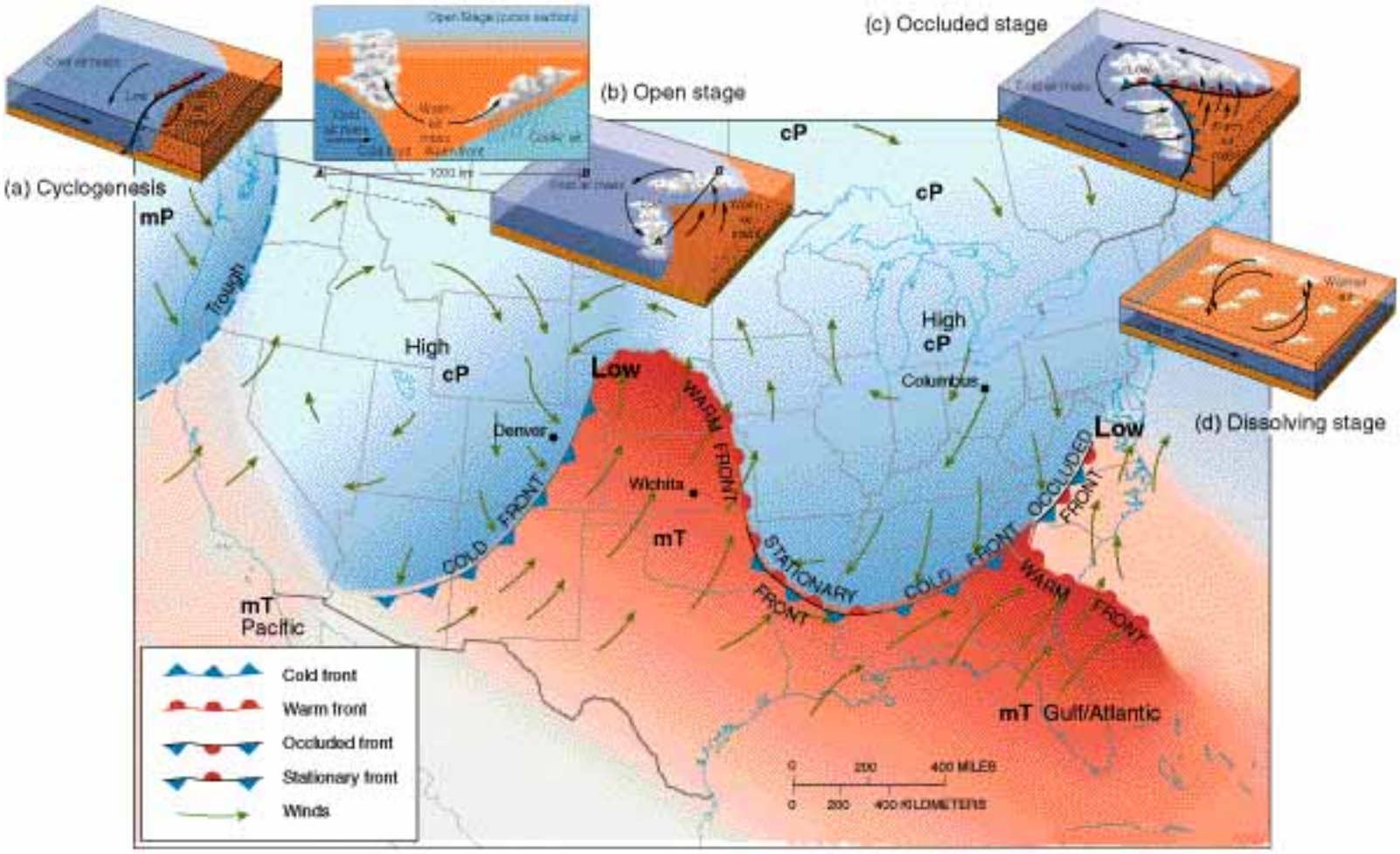
The Track of Cyclonic Systems Shifts with the Seasons
Summer Track is Along the Canadian Border
Winter Track is Across the Southern States



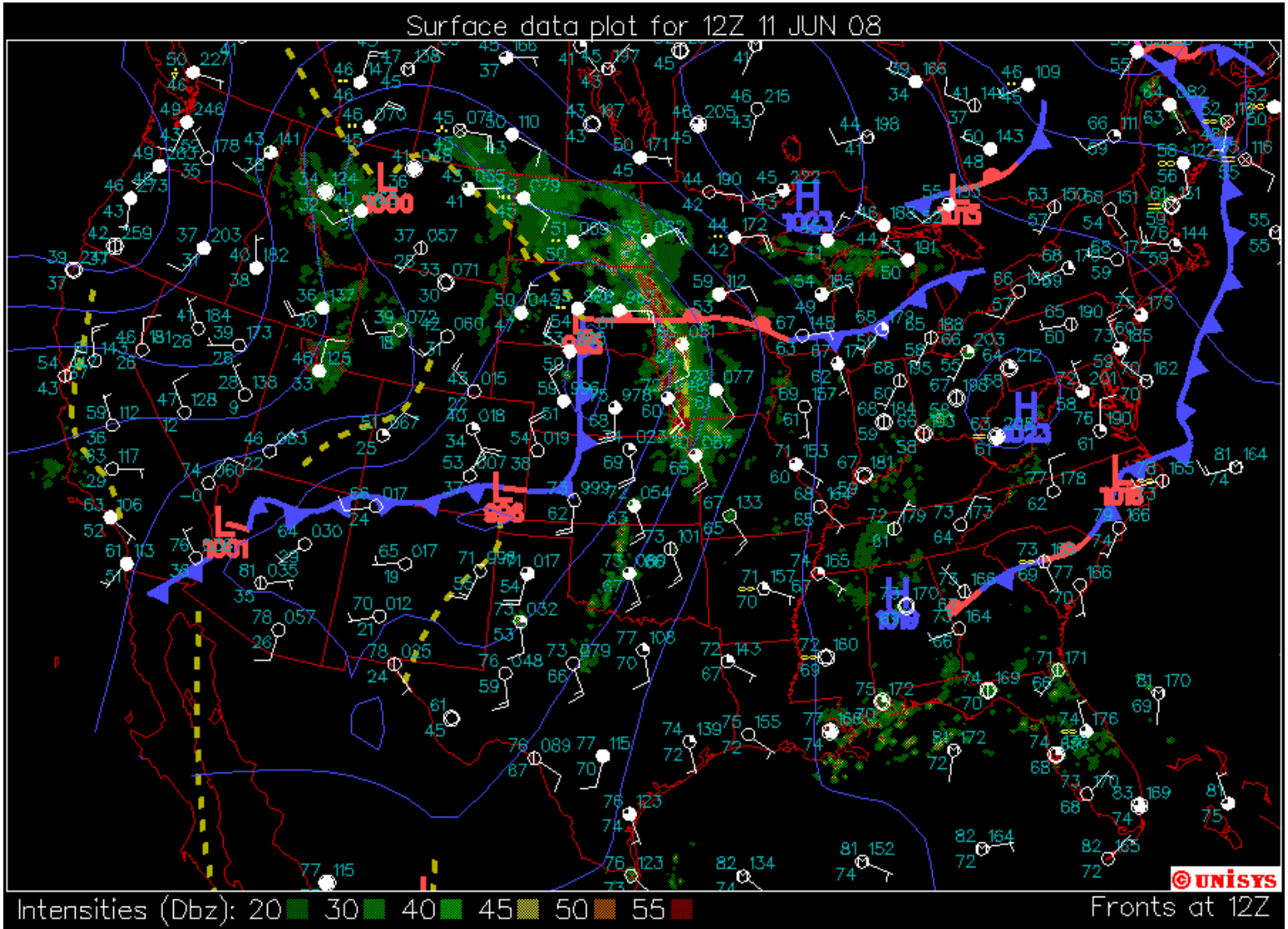
Life Cycle of a Cyclonic Storm System

1. Cyclogenesis
2. Mature or Open Stage
3. Occluded

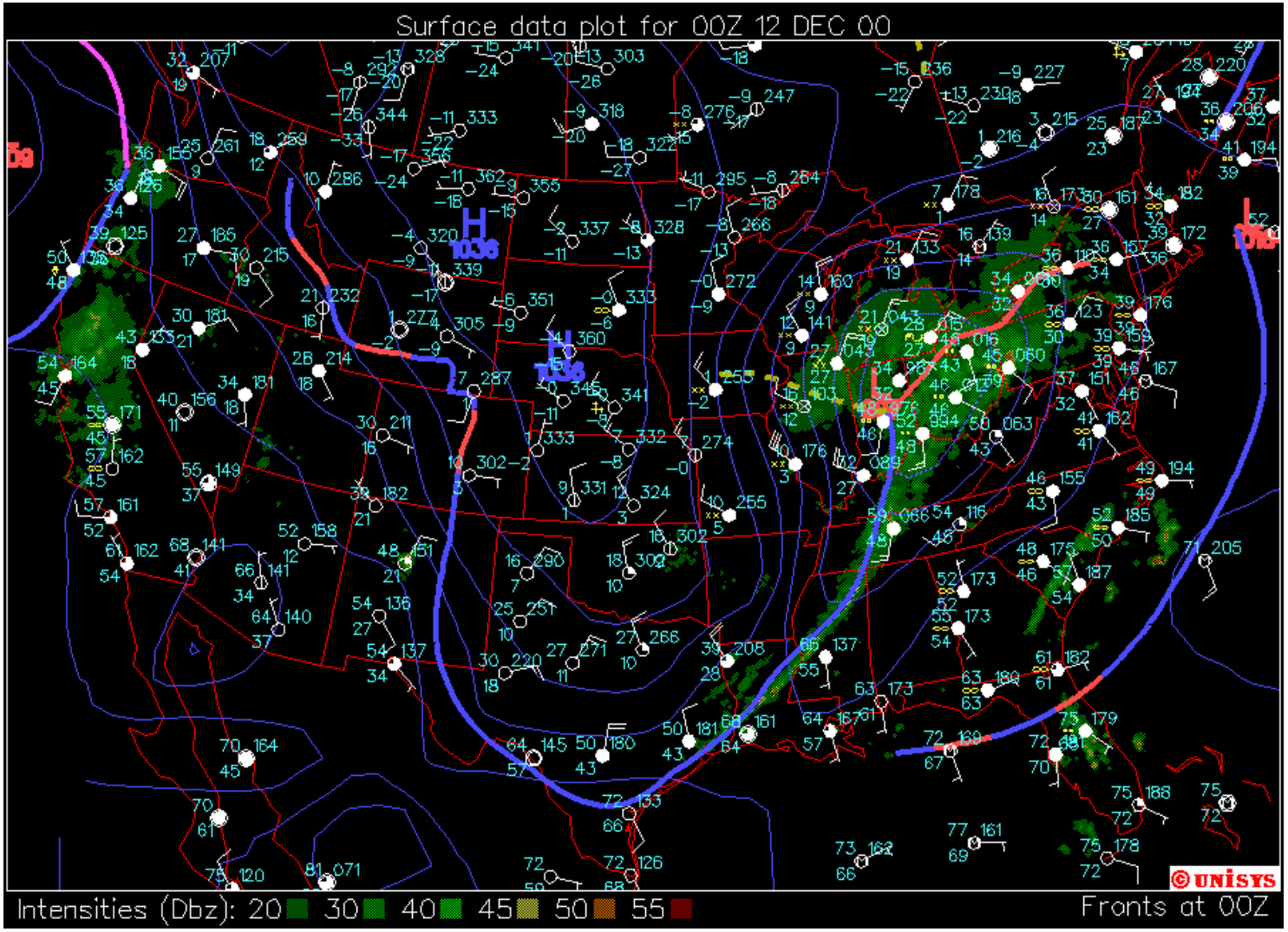
Stages in the Life Cycle of a Cyclonic Storm System



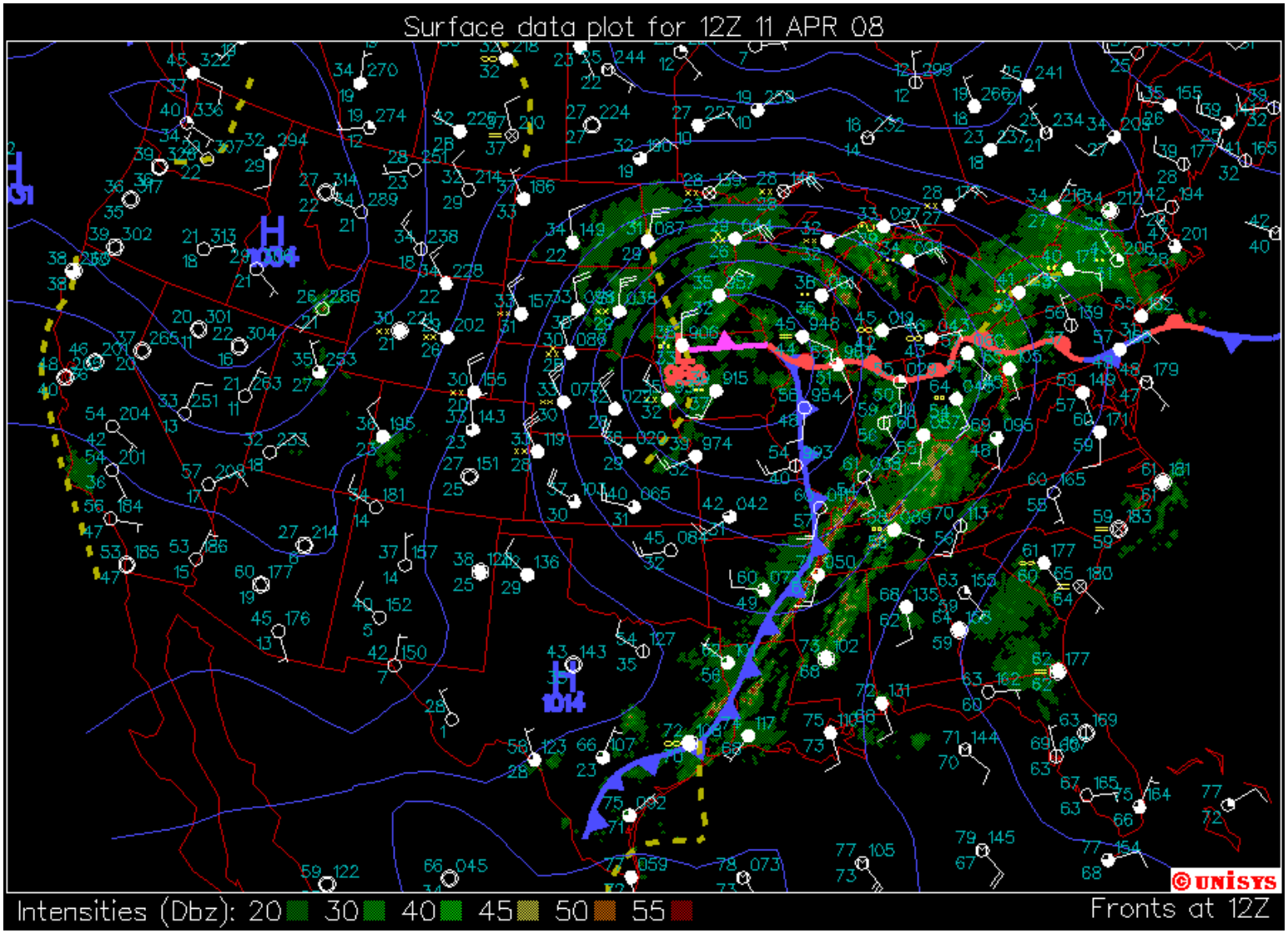
An Open Cyclonic System in South Dakota and Cyclogenesis in Arizona



Open or Mature Stage of Cyclonic Storm System Centered Over Indiana



A Cyclonic System that is Occluded

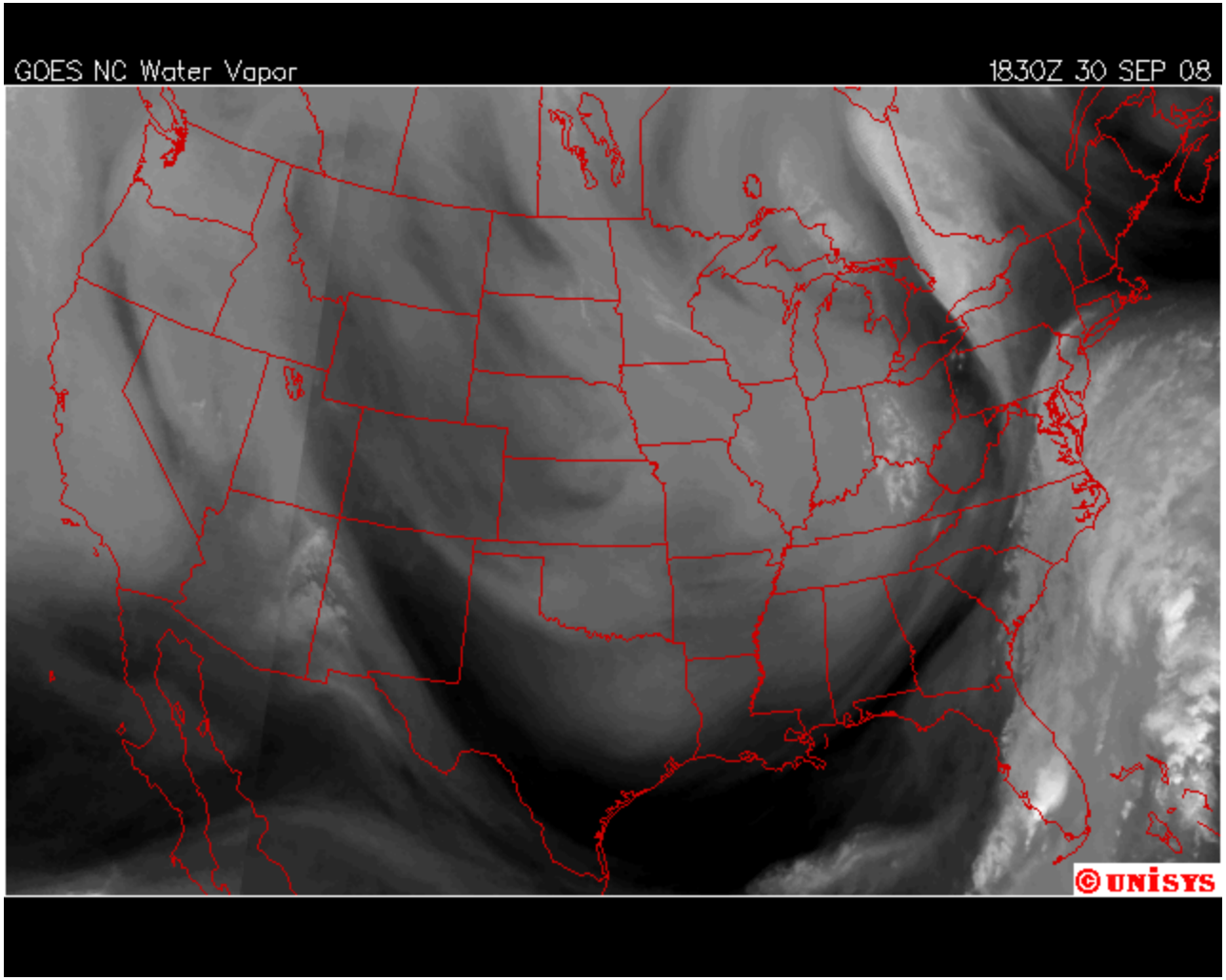


To Get Rain

1. Moisture in the Atmosphere
2. Condensation Nuclei
3. Some Way to Get the Moisture Out, Usually by Lifting and Cooling
    a. Mechanical Lift
        (1.) Fronts – cold, warm, occluded, stationary, gust fronts and dry lines
        (2.) Orographic lifting (mountains)
4. Dynamic Lift
        a. low pressure, trof aloft, divergence aloft
        b. Radiational Cooling – dew, fog drip

A Cyclonic Storm System has many of these features operating at the same time.

Water Vapor Content of the Atmosphere Measured by Satellite

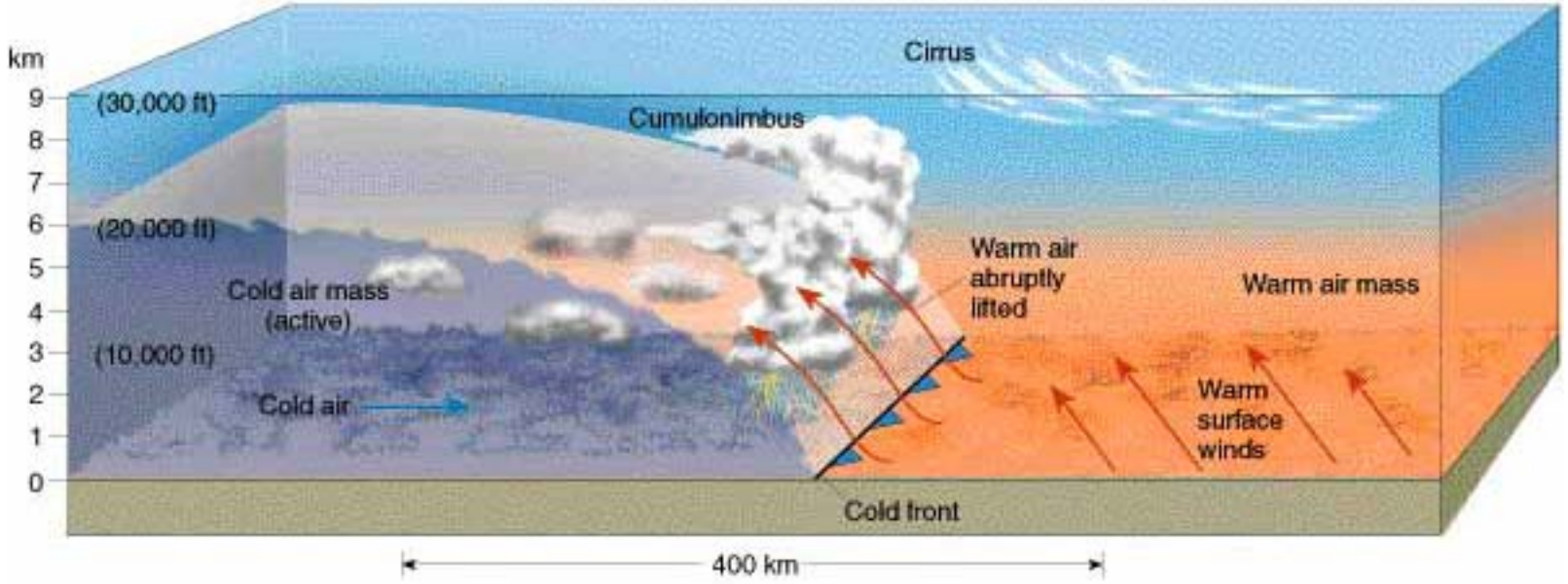


Condensation Nuclei

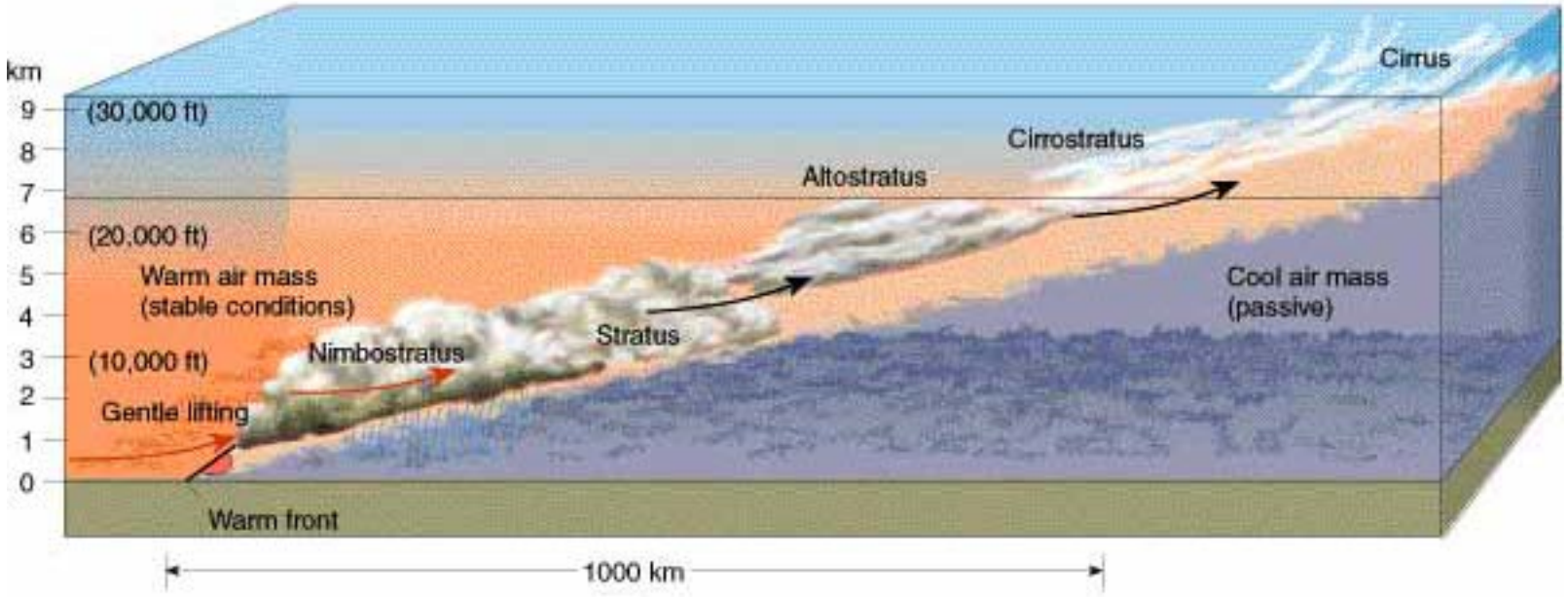
These are any impurity in the atmosphere that water will cling to. Microscopic water droplets have to grow in size to become rain drops.

- Dust
- Salts
- Smoke
- Pollen

Lifting Along a Cold Front Due to Under-running The Cold, Dense Continental Polar Air Pushes the Warm, Humid, Buoyant Maritime Tropical Air Upward

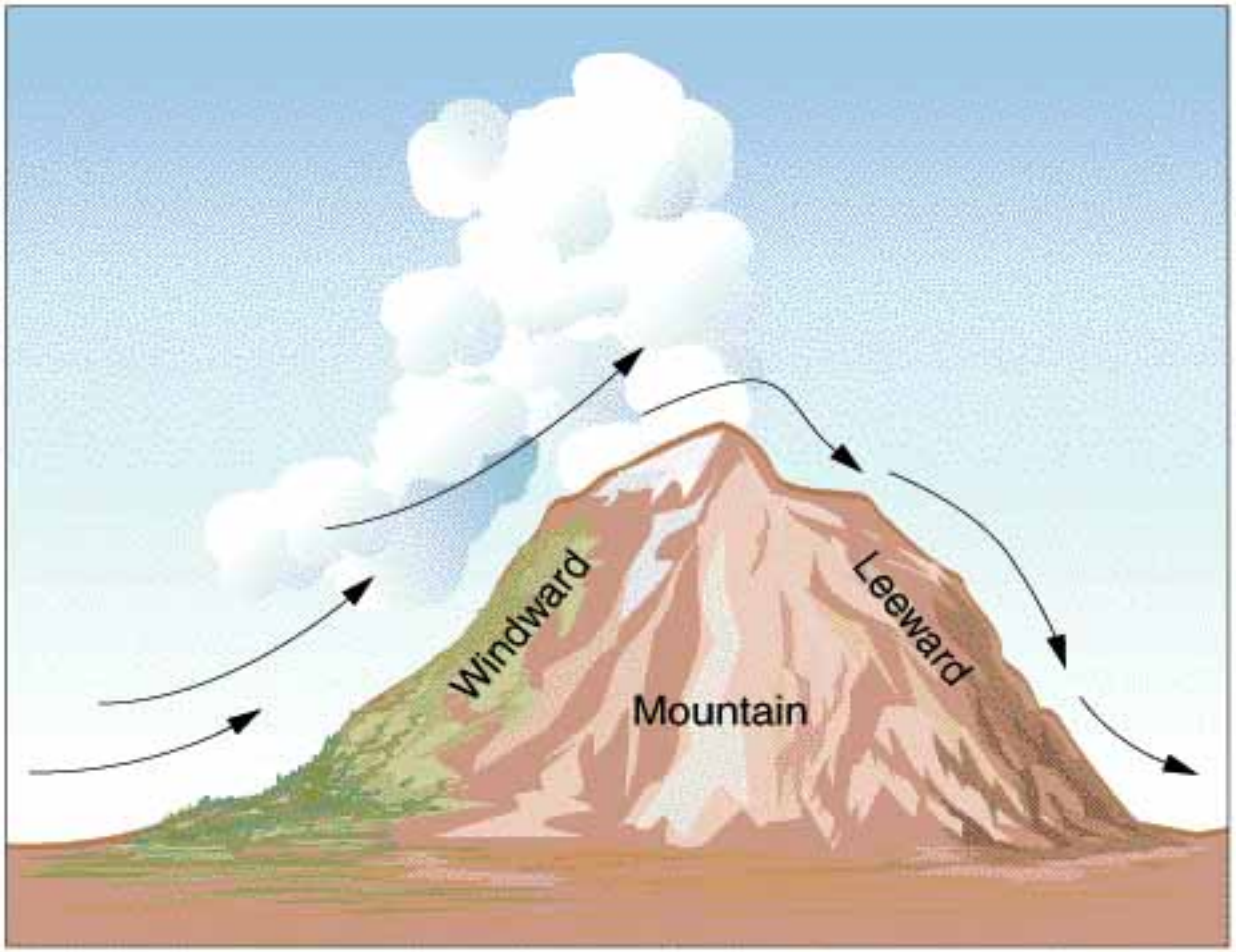


Lifting Along a Warm Front Due to Over-running The Cold, Dense Continental Polar Air Pushes the Warm, Humid, Buoyant Maritime Tropical Air Upward



Thunderstorms and Squall Line Along Cold Front Near the Texas Coast

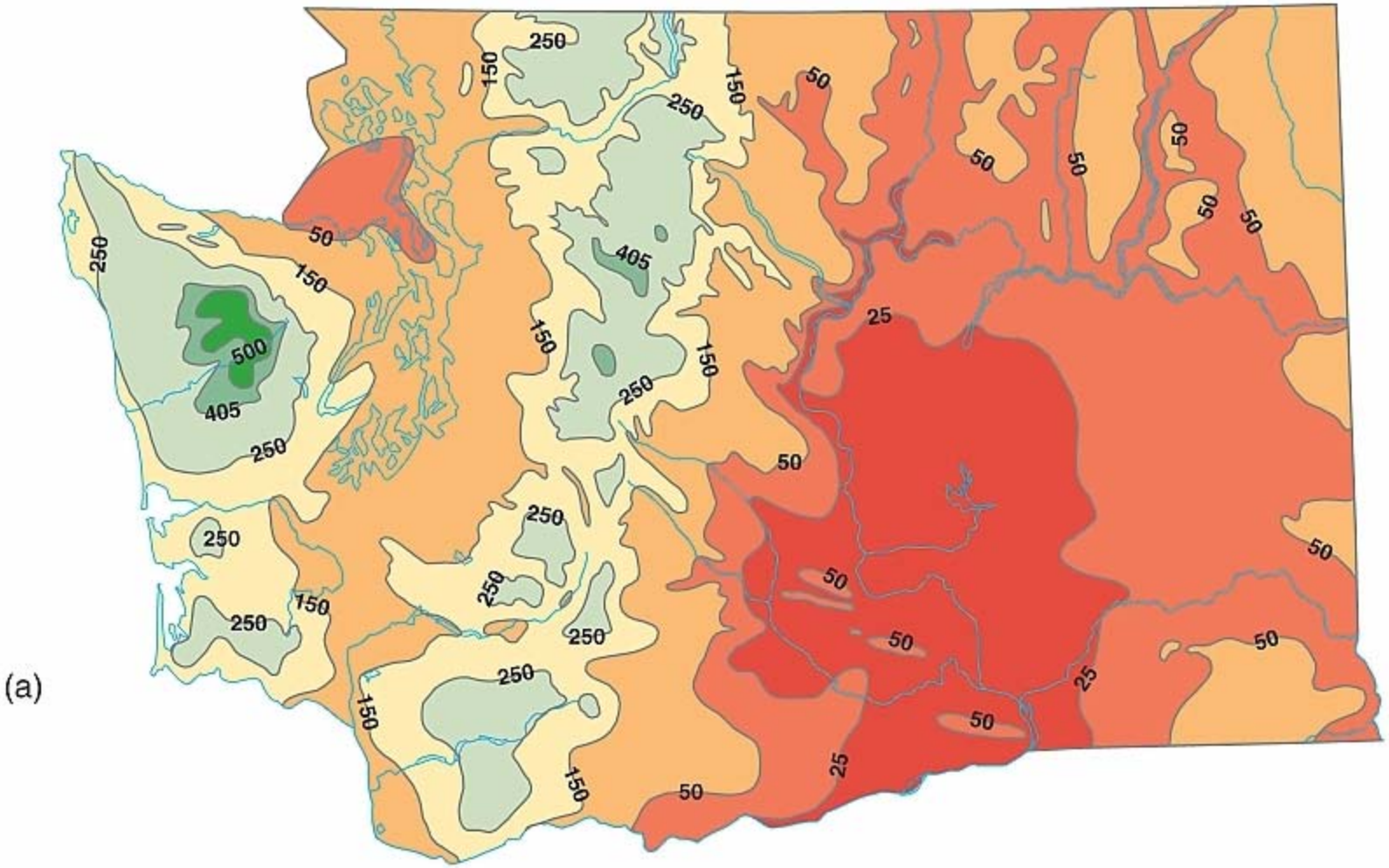
Orographic Lifting Occurs in Mountains Creating a Very Wet Region on the Windward Side and a Very Dry Region on the Leeward Side Called the Rain Shadow



(c) Orographic (barrier)

Annual Precipitation Averages in Washington Are Strongly Controlled by Terrain

Dryness in Eastern Half is Due to Rain Shadow Effect

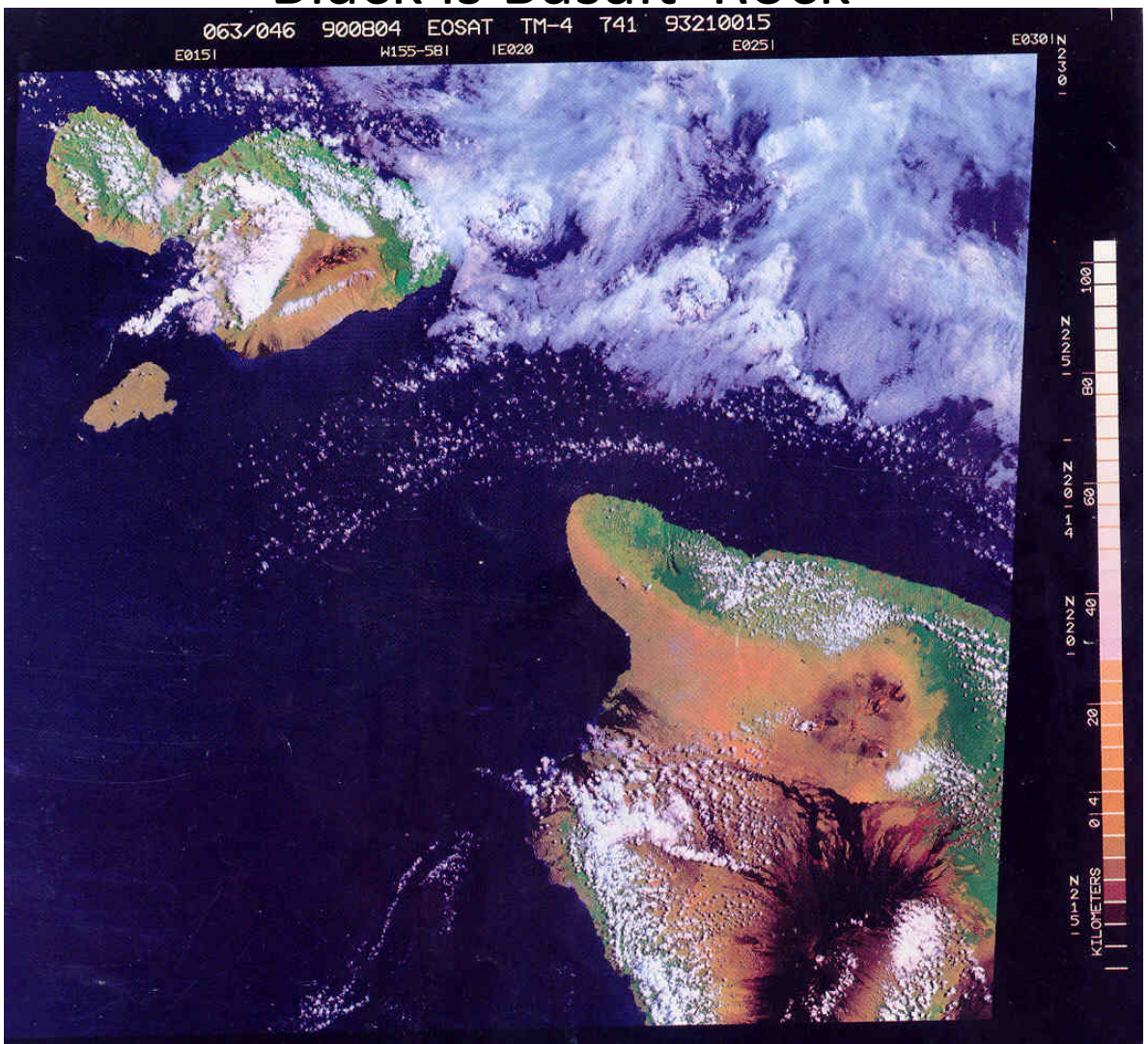


(a)

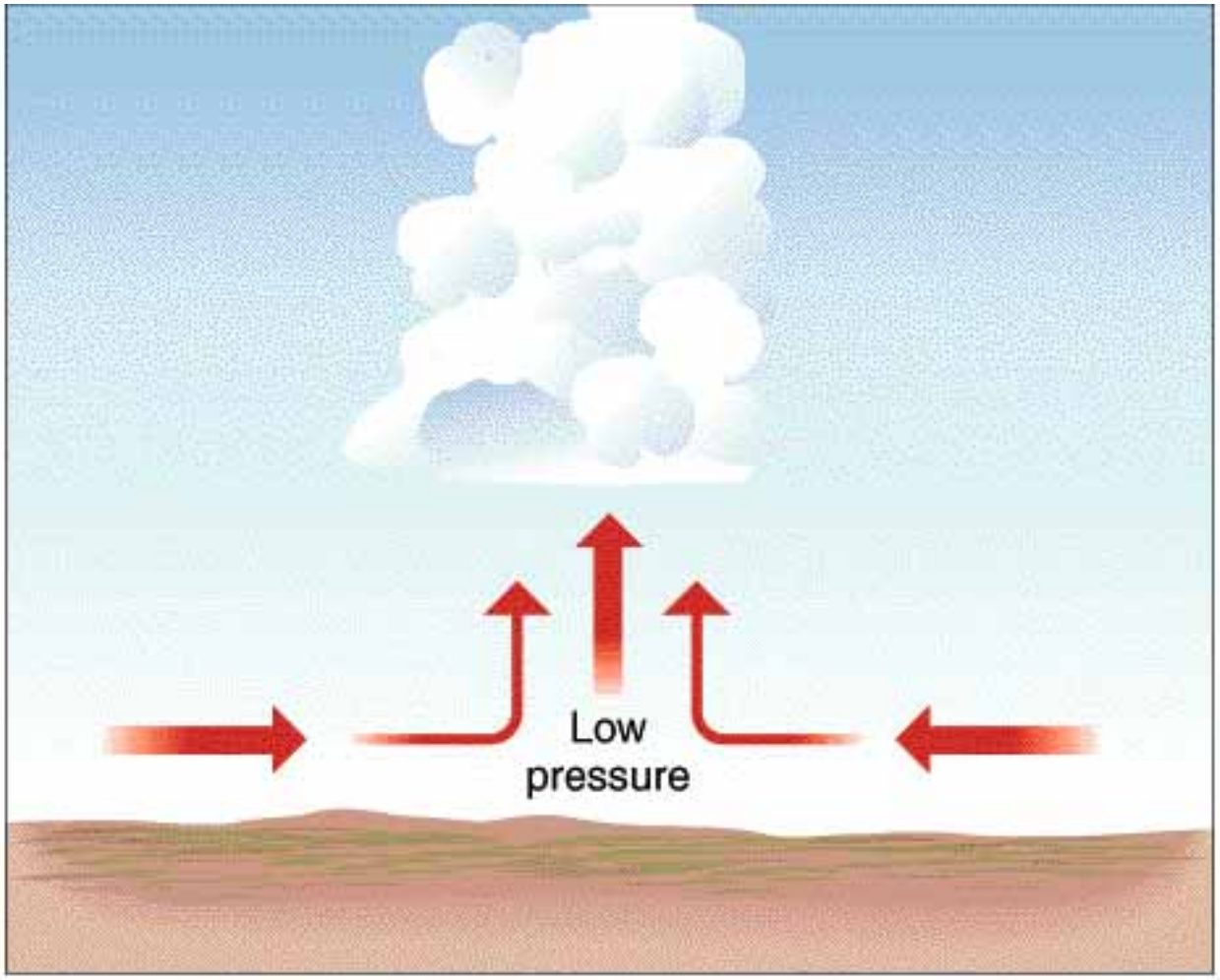
Satellite Image of Western Washington Shows Lush Forest of Windward Side of Mountains and Deserts of Leeward Side

(b)

Green Rainforests Receive 60 – 300 in. of Annual Precipitation
Yellow Brown Areas Receive Less Than 30 in. of Precip.
Black is Basalt Rock

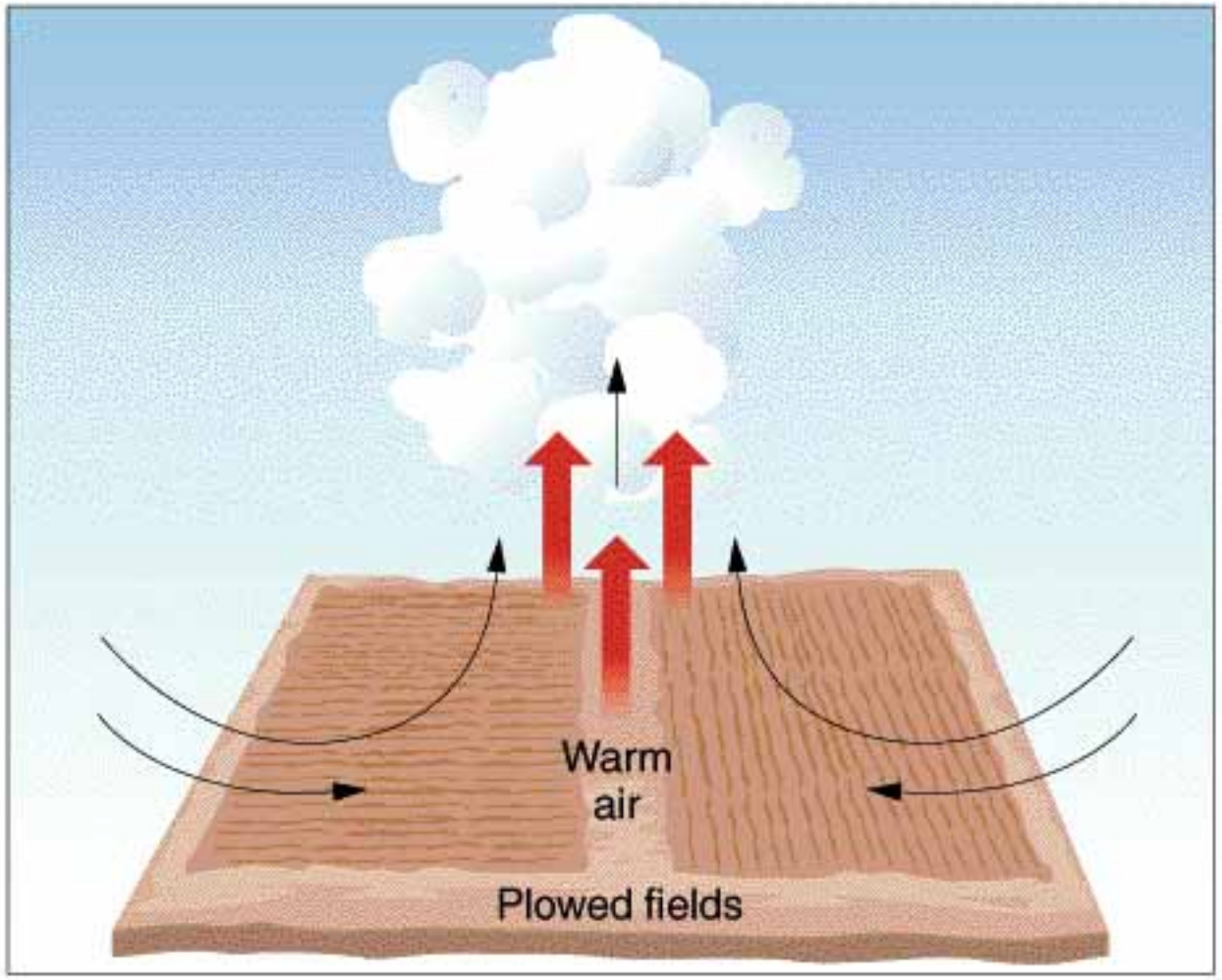


Convergence of Air at the Surface Can Cause Air to Rise



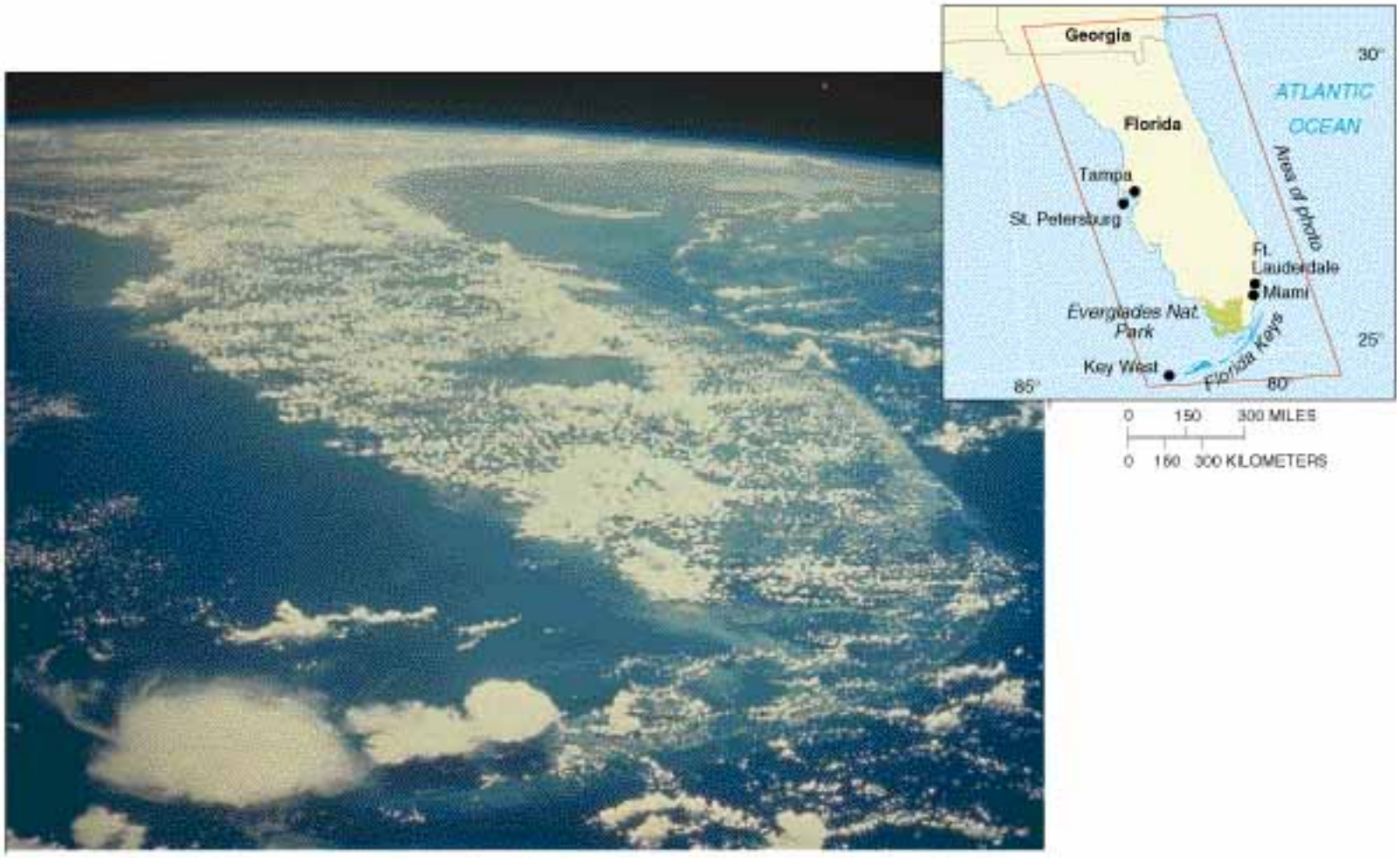
(a) Convergent

Convection Due to Local Heating of the Surface Can Cause Air to Rise



(b) Convectional (local heating)

Convective Clouds Developing over Florida Due to Heating of the Ground



Radiational Cooling at Night Creates Ground Fog in the Morning