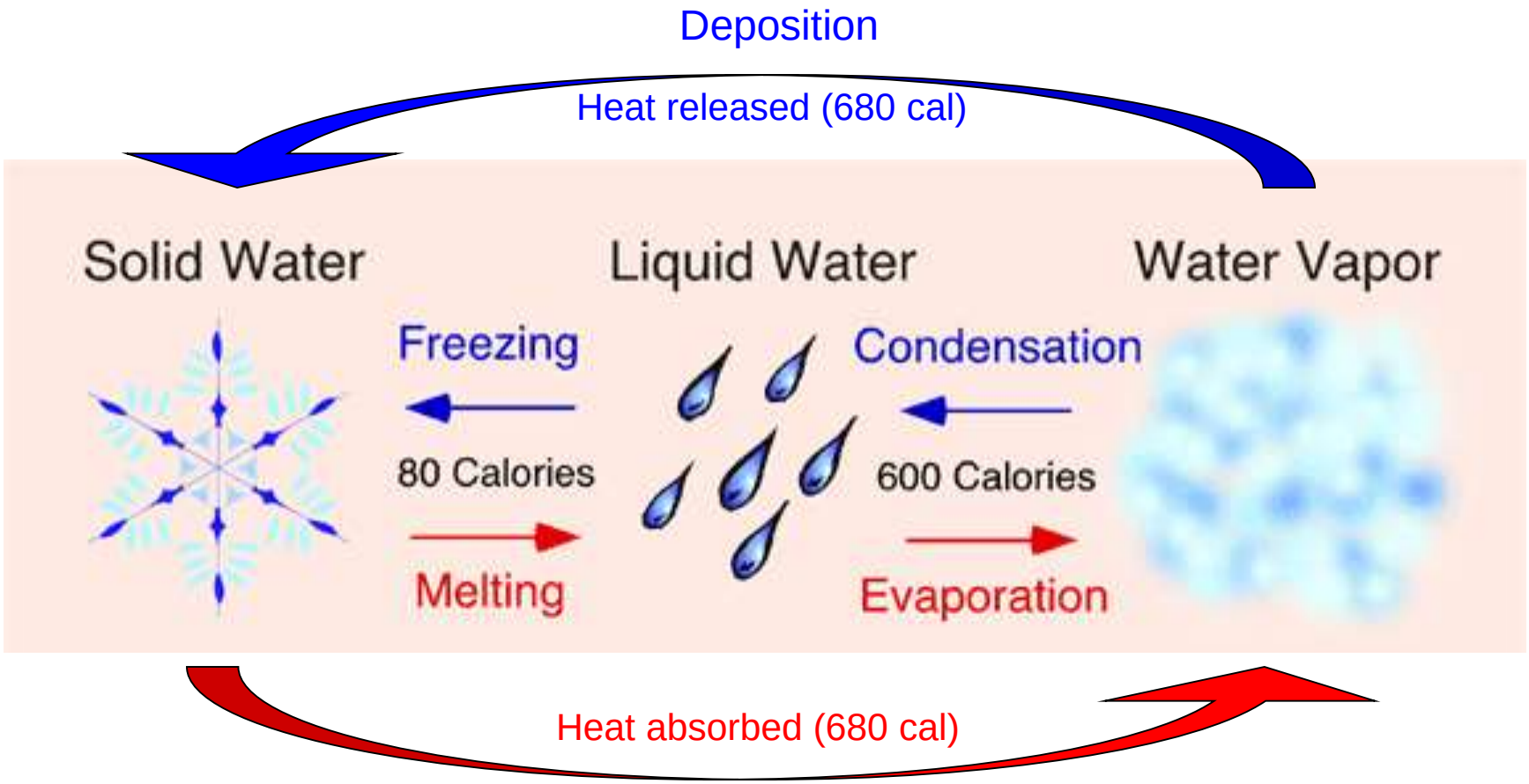
Earth and Space Science

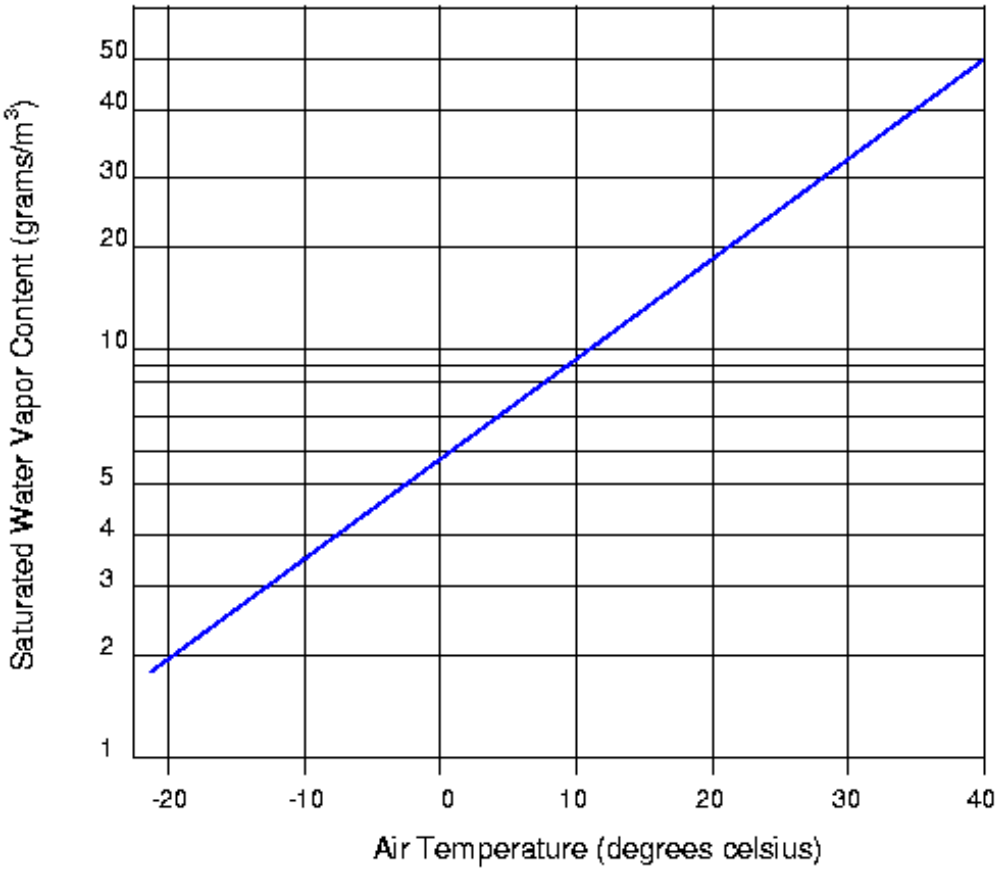
Unit 8 Lecture 1: Moisture

Changes of State



Saturation

- Basically, how much water a specific amount of air can hold at a specific temperature



Specific Humidity

- A measure of the actual quantity of water vapor in a given mass of air.

Relative Humidity

- The ratio of the air's actual water vapor content to its potential water vapor capacity at a given temperature.
- Basically, how much water the air can hold versus how much it actually holds at a certain temperature

Dew Point

- The temperature to which air would have to be cooled to reach saturation.

Adiabatic temperature change

- Changes in temperature based on expanding and compressing the air.
- Expanding air cools because it pushes (does work on) the surrounding air and must cool by an amount equivalent to the energy expended.
- When energy is used to compress air, the motion of the gas molecules increases and therefore the temperature of the air rises.

Dry Adiabatic Rate

- Unsaturated air that cools/heats at a rate of 10°C for every 1000 meters of ascent/descent (1°C for every 100 meters).

Wet Adiabatic Rate

- If air rises high enough, it will cool enough to reach the dew point
- Once air reaches the dew point, latent heat of condensation in the water vapor will be liberated.
- High moisture content: 5°C per 1000m
- Dry air: 9°C per 1000m

Stable Air

- If a bubble of air if forced to rise has a temperature that is lower than that of its environment, it will be denser, and if allowed to move freely, it would sink to its original position.
- It is stable because it resists vertical displacement.

Unstable Air

- A bubble of air that is less dense than the surrounding air would continue to rise until it reached an altitude having the same temperature.

Absolute Stability

- When the environmental lapse rate is less than the wet adiabatic rate.
- The most stable conditions occur when the temperature in a layer of air actually increases with altitude. (called: temperature inversion)
- Usually occurs on clear nights as a result of radiation cooling of the Earth’s surface.

Absolute Instability

- When the environmental lapse rate is greater than the dry adiabatic rate.
- Generally limited to near the Earth's surface.

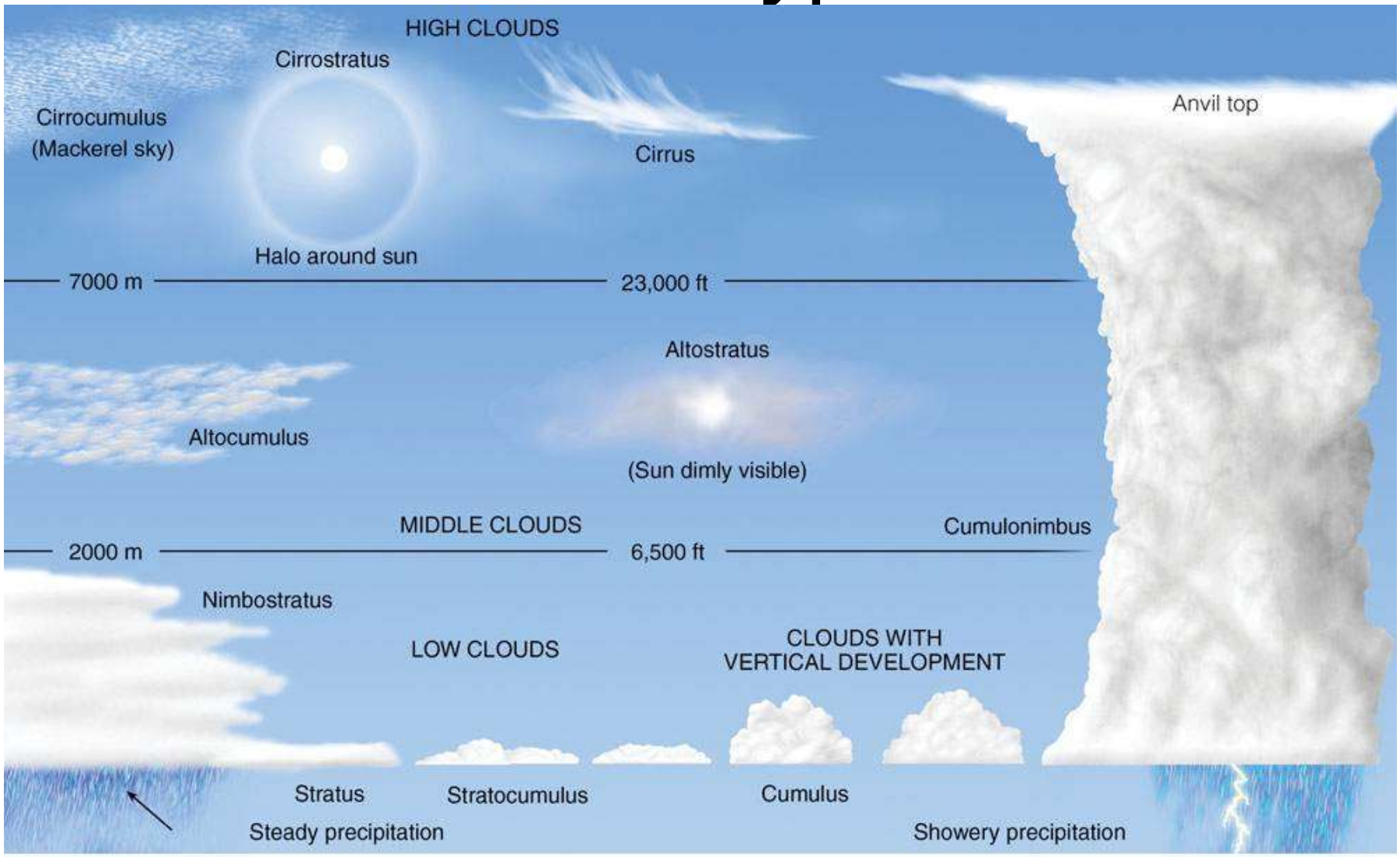
Conditional Instability

- Prevails when most air has an environmental lapse rate between the dry and wet adiabatic rates.
- Simply, the atmosphere is said to be conditionally unstable when it is *stable* for an *unsaturated* parcel of air, but *unstable* for a *saturated* parcel of air.
- The word *conditional* is used because the air must be forced upward before it becomes unstable and rises because of its own buoyancy.

Process That Lift Air

- Orographic lifting – when boundaries, like mountains, act as barriers to moving air and force the air upslope.
- Frontal wedging – when cool air acts as a barrier over which warmer, less dense air rises.
- Convergence – when air masses converge the air has to go somewhere, so the height of the air column increases.

Cloud Types


HIGH CLOUDS
Cirrostratus
Cirrocumulus
(Mackerel sky)
Cirrus
Anvil top
Halo around sun
7000 m
23,000 ft
Altostratus
Altocumulus
(Sun dimly visible)
MIDDLE CLOUDS
Cumulonimbus
2000 m
6,500 ft
Nimbostratus
LOW CLOUDS
CLOUDS WITH
VERTICAL DEVELOPMENT
Stratus
Stratocumulus
Cumulus
Steady precipitation
Showery precipitation

Causes of Fog:
1. Cooling

- Advection Fog – warm moist air over cool surface
- Radiation Fog – cool, clear, calm nights when Earth's surface cools rapidly by radiation.
- Upslope Fog – relatively humid air is forced up slopping plains or steep slopes of mountains.

Causes of Fog:
2. Evaporation

- Steam Fog – when cool air moves over warmer water
- Frontal (or precipitation) Fog – When frontal wedging occurs, warm air is lifted over colder air. If the results is rain, and the cold air below is near the dew point, enough rain will evaporate to produce fog.

Active Reading

- pg. 410 – pg. 416
- Read and summarize