18.1 NOTES

WATER IN OUR ATMOSPHERE
WATER’S CHANGE OF STATE

- PRECIPITATION is any form of water that falls from a cloud.
  - Rain, Snow, Sleet, Hail
- When it comes to understanding atmospheric processes, WATER VAPOR is the most important gas in the atmosphere.
Phase changes of matter

- gas
- solid
- liquid

 Processes:
- sublimation
- deposition
- condensation
- evaporation
- melting
- freezing
WATER’S CHANGES OF STATE

• SOLID TO LIQUID
  • THE PROCESS OF CHANGING STATE, SUCH AS MELTING ICE, REQUIRES THAT ENERGY BE TRANSFERRED IN THE FORM OF HEAT.
  • LATENT HEAT IS THE ENERGY ABSORBED OR RELEASED DURING A CHANGE IN STATE.

• LIQUID TO GAS
  • EVAPORATION: CHANGING A LIQUID TO A GAS.
  • CONDENSATION: WHERE A GAS, LIKE WATER VAPOR, CHANGES TO A LIQUID, LIKE WATER.
WATER’S CHANGES OF STATE

• SOLID TO GAS
  • SUBLIMATION: A SOLID GOES DIRECTLY TO A GAS WITHOUT PASSING THROUGH THE LIQUID STATE.
    • EX: DRY ICE
  • DEPOSITION: WATER VAPOR TURNS DIRECTLY TO A SOLID.
    • EX: FROST
**Sublimation**
Heat absorbed (2592 joules)

**Solid**
- Melting: Heat absorbed (334 joules)
- Freezing: Heat released (334 joules)

**Liquid**
- Evaporation: Heat absorbed (2258 joules)
- Condensation: Heat released (2258 joules)

**Gas**

**Deposition**
Heat released (2592 joules)
HUMIDITY

• **HUMIDITY** IS A GENERAL TERM FOR THE AMOUNT OF WATER VAPOR IN AIR.

• **SATURATION**
  • AIR IS SATURATED WHEN IT CONTAINS THE MAXIMUM QUANTITY OF WATER VAPOR THAT IT CAN HOLD AT ANY GIVEN TEMPERATURE AND PRESSURE.
  • WHEN SATURATED, *WARM* AIR CONTAINS MORE WATER VAPOR THAN *COLD* SATURATED AIR.

• **RELATIVE HUMIDITY** – THE % OF WATER VAPOR IN THE AIR COMPARED TO THE MAXIMUM AMOUNT THE AIR CAN HOLD
  • WHEN THE WATER-VAPOR CONTENT OF AIR REMAINS CONSTANT, LOWERING AIR TEMPERATURE CAUSES AN INCREASE IN RELATIVE HUMIDITY, AND RAISING AIR TEMPERATURE CAUSES A DECREASE IN RELATIVE HUMIDITY.
RELATIVE HUMIDITY VARIES WITH TEMPERATURE

Initial condition

- Temperature: 20°C
- 1 kg air
- 7 grams \( \text{H}_2\text{O} \) vapor

1. Water vapor needed for saturation at 20°C = 14 grams
2. \( \text{H}_2\text{O} \) vapor content = 7 grams
3. Relative humidity = \( \frac{7}{14} = 50\% \)

Cooled to 10°C

- Temperature: 10°C
- 1 kg air
- 7 grams \( \text{H}_2\text{O} \) vapor

1. Water vapor needed for saturation at 10°C = 7 grams
2. \( \text{H}_2\text{O} \) vapor content = 7 grams
3. Relative humidity = \( \frac{7}{7} = 100\% \)

Cooled to 0°C

- Temperature: 0°C
- 1 kg air
- 3.5 grams \( \text{H}_2\text{O} \) vapor

1. Water vapor needed for saturation at 0°C = 3.5 grams
2. \( \text{H}_2\text{O} \) vapor content = 3.5 grams
3. Relative humidity = \( \frac{3.5}{3.5} = 100\% \)
HUMIDITY

• **DEW POINT** is the temperature to which a parcel of air would need to be cooled to reach saturation.

• **DEW** forms usually during the evening hours when objects near the ground often cool below the dew-point temperature and become coated with water.
A hygrometer is an instrument to measure relative humidity.

A psychrometer is a hygrometer with dry- and wet-bulb thermometers. Evaporation of water from the wet bulb makes air temperature appear lower than the dry bulb’s measurement. The two temperatures are compared to determine the relative humidity.