Clouds and Precipitation
Pressure and Wind
Stability of Atmosphere

• Air rises due to a number of factors
• Expands as it rises: cools as it does so
  – Can calculate the new temperature
  – Use the adiabatic lapse rate:
    • Dry for unsaturated
    • Wet for saturated
  – Compare the temperature of the air that has risen to the temperature of the air at that height
  – Use the environmental lapse rate
    • Higher density air that has risen is stable (cooler)
    • Lower density air that has risen is unstable (warmer)
Stability

- Environmental lapse rate
  - $5^\circ\text{C}/1000$ m
- Dry adiabatic lapse rate
  - $10^\circ\text{C}/1000$ m
- Rising air is cooler than area it rises into
- Stable!!
Cloud Development

- Air cools upon rising
- Cools to dew–point temperature
- Condensation begins
- “Lifting condensation level”
Cloud Shapes

- **Cirrus**—curl (of hair): thin wisps
- **Stratus**—blanket: extensive layers
- **Cumulus**—pile: puffy masses

**Additional modifier of name**

- **Nimbus** = rain
  - **Cumulonimbus**: puffy rain clouds
  - **Nimbostratus**: layered rain clouds
Cloud Groups

- High clouds—6000 m or more above surface
- Middle clouds—2000 m to 6000 m above
- Low clouds—less than 2000 m above surface
- Clouds of vertical development
  - Present through more than one level
  - Product of atmospheric instability
G. Cumulus
Cloud classification

High clouds
- Cirrocumulus
- 6000 m

Middle clouds
- Altocumulus
- 4000 m

Low clouds
- Nimbostratus
- Stratus
- 2000 m
Cloud classification

- Cirrostratus
- Cirrus
- Altostratus
- Stratocumulus
- Cumulus (fair weather)
- Cumulonimbus
- Clouds with vertical development

Earths surface
Willamette Valley Fog
Storms of 2011

- Tornadic activity at all time high in May
- Wide swath across southeast

http://media.nola.com/weather_impact/photo/severe-weather-27apr11-0745-utc-animatedgif-4f51095f52e087b4.gif
High rainfall led to severe flooding

• 75-year flood?
• Last happened in 1937…
• Some areas are at record levels
Condensation in clouds

- Condensation nucleus
  0.0002 millimeters

- Large cloud droplet
  0.05 millimeters

- Typical cloud droplet
  0.02 millimeters

- Typical raindrop
  2 millimeters
Collision and coalescence:

A. Typical cloud droplets (0.02 millimeters) merge with a larger cloud droplet (0.05 millimeters).

B. Merging with typical cloud droplets grow into a typical rain drop (2 millimeters).

C. A large rain drop (4 millimeters) breaks into several small drops which grow by accretion.
 Bergeron Process of ice-crystal growth

- Water molecule
- Ice crystal
- Cloud droplet
- Snow crystal
Bergeron Process

- Snow falls from clouds
- Melts as it is falling
- Result is rain
- Most common method of precipitation in the mid-latitudes
Forms of precipitation

- Mist: tiny droplets
- Drizzle: small droplet
- Rain: larger drops
- Sleet: small frozen raindrops
- Glaze: rain that freezes upon contact
- Rime: frost deposition
- Snow: solid flake-shaped crystals
- Hail: solid concentric balls
- Graupel: collected snowflakes
Precipitation measurement

![Diagram showing a collecting funnel and a measuring tube for measuring precipitation.](image-url)

- **Collecting funnel**
- **Measuring tube**
  - 
  - 
  - 
  - 
  - 
  - 10 inches

1 inch of rain