The Earth's Atmosphere

This chapter discusses:
1. Gases in Earth's atmosphere
2. Vertical structure of atmospheric pressure & temperature
3. Types of weather & climate in the atmosphere

Solar Energy as Radiation

Nearly 150 million kilometers separate the sun and earth, yet solar radiation drives earth's weather.

Composition of Atmosphere

- Nitrogen - 78%
- Oxygen - 21%
- Water Vapor - 0 to 4%
- Carbon Dioxide - .037%
- Other gases make up the rest

Atmospheric Gases

- Nitrogen, oxygen, argon, water vapor, carbon dioxide, and most other gases are invisible.
- Clouds are not gas, but condensed vapor in the form of liquid droplets.
- Ground based smog, which is visible, contains reactants of nitrogen and ozone.

Earth's Atmosphere

99% of atmospheric gases, including water vapor, extend only 30 kilometer (km) above earth's surface.

Most of our weather, however, occurs within the first 10 to 15 km.

Ozone - is the primary ingredient of smog!
Variable & Increasing Gases

Nitrogen and oxygen concentrations experience little change, but carbon dioxide, methane, nitrous oxides, and chlorofluorocarbons are greenhouse gases experiencing discernable increases in concentration. CO2 has risen more than 18% since 1958. Fossil fuels are the biggest problem!

Atmospheric Greenhouse Effect

- The warming of the atmosphere by its absorbing and emitting infrared radiation while allowing shortwave radiation to pass through. The gases mainly responsible for the earth’s atmospheric greenhouse effect are water vapor and carbon dioxide.

Aerosols & Pollutants

Human and natural activities displace tiny soil, salt, and ash particles as suspended aerosols, as well as sulfur and nitrogen oxides, and hydrocarbons as pollutants.

Pressure & Density

Gravity pulls gases toward earth’s surface, and the whole column of gases weighs 14.7 psi at sea level, a pressure of 1013.25 mb or 29.92 in.Hg. The amount of force exerted over an area of surface is called Air pressure. Air Density is the number of air molecules in a given Space volume.

Lapse Rate

- The rate at which air temperature decreases with height.
- The standard (average) lapse rate in the lower atmosphere is about 6.5°C per 1 km or 3.6°F per 1000 ft.
Temperature Inversion

• An increase in air temperature with height often called simply an inversion.

• Radiosonde – an instrument that measures the vertical profile of air temperature in the atmosphere (sometimes exceeding 100,000 ft)

Atmospheric Layers

8 layers are defined by constant trends in average air temperature (which changes with pressure and radiation), where the outer exosphere is not shown.

1. Troposphere
2. Tropopause
3. Stratosphere
4. Stratopause
5. Mesosphere
6. Mesopause
7. Thermosphere
8. Exosphere

Figure 1.7

Troposphere – Temp decrease w/ height
Most of our weather occurs in this layer
Varies in height around the globe, but
Averages about 11 km in height.

Tropopause
Separates Troposphere from Stratosphere
Generally higher in winter
Lower in summer

Figure 1.7

Stratosphere
Temperature inversion in stratosphere
Ozone plays a major part in heating the air

Figure 1.7

Mesosphere
Middle atmosphere – Air thin, pressure low,
Need oxygen to live in this region. Air
Quite Cold -90°C (-130°F) near the top of mesosphere

Figure 1.7

Atmosphere
Air thin, pressure low,
Need nitrogen to live in this region. Air
Slightly Cold -60°F near the top of atmosphere

Figure 1.7
Atmospheric Layers

Thermosphere

“The hot zone” - oxygen molecules absorb energy from outer Rare emitting the heat. Very few atoms and molecules in this region.