1/2008 VERSION

Chapter 1- Composition and Structure of the Atmosphere

Understanding Weather and Climate
Aguado and Burt

ATMO 1300

Definitions

- Atmosphere - The gases, droplets and particles surrounding the Earth's surface.
- Meteorology – The science that studies the atmosphere and its processes.
- Climatology – The science that studies long-term atmospheric conditions
- Weather – Short-term atmospheric phenomena/conditions

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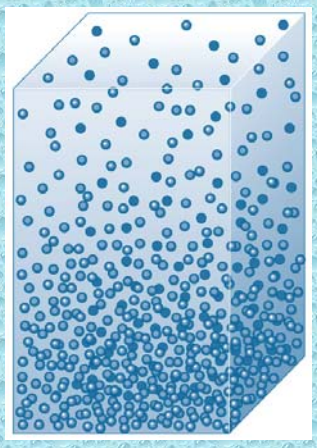
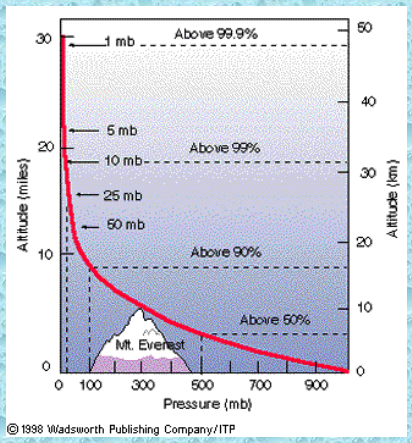
Thickness of the Atmosphere

- The atmosphere becomes thinner with height
- There is no easy way to establish the atmosphere's upper boundary



Thickness of the Atmosphere

- Top of a thunderstorm = ~12 km
- 100 km above sea level - 99.99997 % of the atmosphere is below this height



Thickness of the Atmosphere

Composition of the Atmosphere

- The atmosphere is a mixture of:
  - gases
  - microscopic solid particles
  - water droplets

Atmospheric Gases

- Permanent – Gases that form a constant proportion of the atmospheric mass. → O_2 to breath
- Variable – Gases whose distribution in the atmosphere varies in both time and space.

Permanent Gases

Table 1-2

Constituent	Formula	Percent by Volume	Molecular Weight
Nitrogen	N_2	78.08	28.01
Oxygen	O_2	20.95	32.00
Argon	Ar	0.93	39.95
Neon	Ne	0.002	20.18
Helium	He	0.0005	4.00
Krypton	Kr	0.0001	83.8
Xenon	Xe	0.00009	131.3
Hydrogen	H_2	0.00005	2.02

Variable Gases

Table 1-3

Constituent	Formula	Percent by Volume	Molecular Weight
Water Vapor	H_2O	0.25	18.01
Carbon Dioxide	CO_2	0.036	44.01
Ozone	O_3	0.01	48.00

Aerosols

Source: US Defense website

Vertical Structure of the Atmosphere

- Layers in the atmosphere
  - Density
  - Chemical Composition
  - Electrical Characteristics
  - Temperature

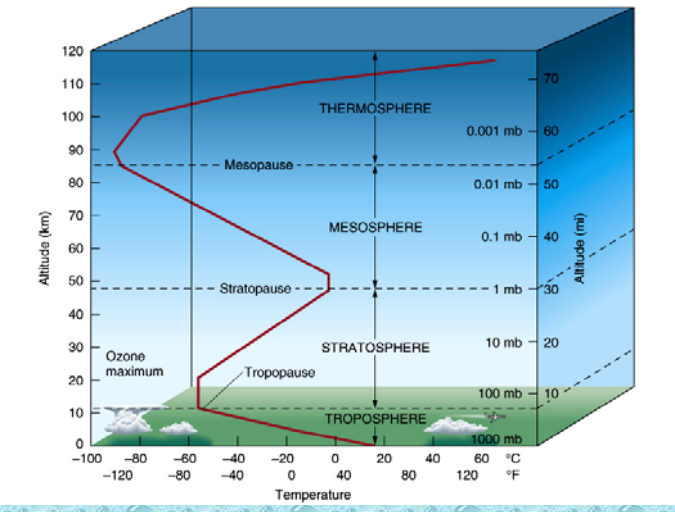
Characterizing with Chemical Composition

- Homosphere - Region within ~80 km of the Earth's surface where there is chemical homogeneity.
- Heterosphere - Located above the Homosphere where lighter gases become more dominant with height.

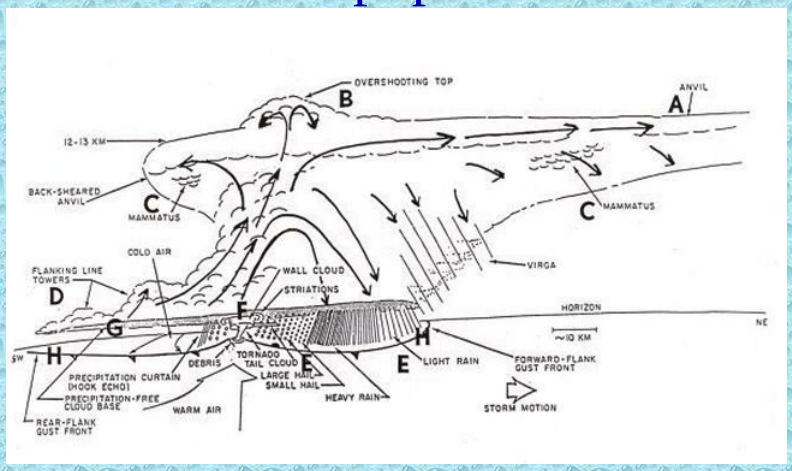
Characterizing with Temperature

- Standard Atmosphere
  - Troposphere (lowest)
  - Stratosphere
  - Mesosphere
  - Thermosphere (highest)

Characterizing with Temperature



Tropopause



Overshooting Top of a Thunderstorm

Characterizing with Electrical Composition

- Ionosphere
  - Layer extends from the upper mesosphere into the thermosphere.
  - It contains large numbers of electrically charged particles called ions.
    - Ions are formed when electrically neutral atoms or molecules lose one or more electrons and become positively charged. (solar energy)
  - Responsible for the aurora borealis (northern lights)
  - Reflects AM radio waves