Chapter 3: Atmosphere

I. Composition of the Atmosphere
   A. The Gases
      1. Air—synonymous with atmosphere, and is a mixture of gases, mainly nitrogen and oxygen.
         a) Basic composition of air:
            (1) Nitrogen—78%
            (2) Oxygen—21%
            (3) Argon—nearly 1%
            (4) Neon, helium, methane, krypton, hydrogen, water vapor, carbon dioxide, ozone, carbon monoxide, sulfur dioxide, nitrogen oxides, and various hydrocarbons—trace amounts
      2. Only water vapor and carbon dioxide have a significant effect on weather and climate.
         a) Water vapor determines the humidity of the atmosphere, is the source of all clouds and precipitation, and is intimately involved in the storage, movement, and release of heat energy.
         b) Water vapor and atmospheric carbon dioxide significantly affect the climate because they can absorb infrared radiation, keeping the lower atmosphere warm.
      3. Ozone—a molecule made up of three oxygen atoms (O₃). Mostly concentrated in the ozone layer, where it helps to absorb deadly ultraviolet solar radiation and protect animal life.
      4. Proportion of carbon monoxide, sulfur dioxide, nitrogen oxides, and various hydrocarbons is also increasing, from emissions from factories and cars.
         a) All are hazardous to life and may have an effect on climate.
   B. The Particles
      1. Particulates—solid and liquid particles found in the atmosphere; can be both visible to eye and invisible; come from both natural and human-made sources.
         a) Larger particles are mainly water and ice.
      2. Particulates affect the weather and climate in two ways:
         a) They are hygroscopic (they absorb water), and water vapor collects around them, which contributes to cloud formation;
         b) They can either absorb or reflect sunlight, thus decreasing the amount of solar energy that reaches Earth’s surface.

II. Vertical Structure of Atmosphere
   A. Most weather phenomena occur in lower atmosphere.
   B. Temperature
      1. Thermal layer—There are five thermal layers in the atmosphere:
         (1) Troposphere—the lowest thermal layer of the atmosphere, in which temperature decreases with height. Zone of Mixing where our weather happens.
         (2) Tropopause—a transition zone at the top of the troposphere, where temperature ceases to decrease with height.
         (3) Stratosphere—atmospheric layer directly above troposphere, where temperature increases with height.
         (4) Stratopause—top of the stratosphere, elevation about 48 kilometers (30 miles), were maximum temperature is reached.
         (5) Mesosphere
         (6) Mesopause
         (7) Thermosphere
         (8) Exosphere—the highest zone of Earth’s atmosphere.
C. **Pressure**
   1. Atmospheric pressure is basically the weight of overlying air. Thus air pressure is normally highest at sea level and rapidly decreases with altitude.

D. **Composition**
   1. Principal gases of atmosphere have a uniform vertical distribution in the lowest 80 kilometers (50 miles) of the atmosphere.
   2. **Homosphere**—zone of homogeneous composition; in both troposphere and stratosphere.
   3. **Heterosphere**—zone of heterogeneous composition; begins in mesosphere and continues through exosphere; where gases tend to be layered according to their molecular masses rather than having the homogenous composition of the homosphere.
   4. **Ozonosphere**—ozone layer; the zone of relatively rich concentration of ozone in the atmosphere, between about 15 to 48 kilometers (9 to 30 miles) high, that absorbs ultraviolet radiation.
   5. **Ionosphere**—deep layer of ions, electrically charged molecules and atoms, in mesosphere (middle and upper parts) and thermosphere (lower part) that aids in long-distance communication by reflecting radio waves back to Earth. Also generates auroral displays.

### III. Weather and Climate

A. **Weather**—short-run atmospheric conditions that exist for a given time in a specific area.

B. **Climate**—the pattern or aggregate of day-to-day weather conditions over a long period of days, encompassing both the average characteristics and the variations and extremes.

C. **The Elements of Weather and Climate**
   1. **Elements (of weather/climate)**—There are four main elements, or variables, of weather and climate:
      a) Temperature
      b) Pressure
      c) Wind
      d) Moisture

D. **The Controls of Weather and Climate**
   1. **Controls (of weather/climate)**—There are seven principal controls (semipermanent attributes of Earth) that cause or influence the elements of weather and climate:
      a) **Latitude**—influences the element of temperature, as the basic function of heat over Earth from sunlight is a function of latitude.
      b) **Distribution of land and water**—influences both temperature and moisture, with continental climates and maritime (oceanic) climates differing greatly.
      c) **General circulation of the atmosphere**—influences most elements of weather and climate. Although the atmosphere is in constant motion, the troposphere displays a semipermanent pattern on major wind and pressure systems.
      d) **General circulation of the oceans**—influences most elements of weather and climate in a similar fashion as the atmosphere, through the horizontal transfer of heat, but not to the same extent that atmosphere does.
      e) **Elevation**—influences temperature, pressure, and moisture content, with them generally are decreasing with increasing altitude.
      f) **Topographic barriers**—influence wind flow by diverting it.
      g) **Storms**—result from interaction of the other climate controls, but then create their own specialized weather circumstances like other controls.