Summary of World Climates

1. The climate classification devised by Wladimir Köppen (1846–1940) is the best-known and most used tool for presenting the world pattern of climates.

   a. The Köppen classification uses easily obtained data: mean monthly and annual values of temperature and precipitation.

   b. Furthermore, the criteria are unambiguous, simple to apply, and divide the world into climate regions in a realistic way. Köppen believed that the distribution of natural vegetation was the best expression of an overall climate. Consequently, the boundaries he chose were largely based on the limits of certain plant associations.

   c. Köppen recognized five principal climate groups, each designated with a capital letter: The fifth, the B group, has precipitation as its primary criterion.

      i. A (humid tropical)
      ii. B (dry)
      iii. C (humid middle-latitude, mild winters)
      iv. D (humid middle-latitude, severe winters)
      v. E (polar)

2. Brief Descriptions of Climate types

   a. Wet Climates (A)

      i. Wet tropics (Af, Am) - Situated along the equator, these climates have constant high temperatures and year-round rainfall combine to produce the most luxuriant vegetation in the climatic realm—the tropical rain forest.

         1. Temperatures in these regions usually average 25°C (77°F) or more each month and the daily temperature variations characteristically greatly exceed seasonal differences. Precipitation in Af and Am climates is normally from 175 to 250 centimeters (68 to 98 inches) per year and is more variable than temperature, both seasonally and from place to place.

         2. Thermally induced convection coupled with convergence along the intertropical convergence zone (ITCZ) leads to widespread ascent of the warm, humid, unstable air and ideal conditions for precipitation.

      ii. Tropical wet and dry (Aw) This climatic region is a transitional zone between the rainy tropics and the subtropical steppes.

         1. Here, the rain forest gives way to the savanna, a tropical grassland with scattered deciduous trees. Only modest temperature differences exist between the wet tropics and the tropical wet and dry regions.

         2. The primary factor that distinguishes the Aw climate from Af and Am is precipitation.

            a. In Aw regions the precipitation is typically between 100 and 150 centimeters (40 to 60 inches) per year and exhibits some seasonal character—wet summers followed by dry winters.

            b. In much of India, southeast Asia, and portions of Australia, these alternating periods of rainfall and drought are associated with the monsoon, wind systems with a pronounced seasonal reversal of direction.

            c. The Cw climate, which is subtropical instead of tropical, is a variant of Aw.
b. **Dry Climates (B)** Dry regions of the world cover about 30 percent of Earth's land area. Other than their meager yearly rainfall, the most characteristic feature of dry climates is that precipitation is very unreliable.

i. Climatologists define a **dry climate** as one in which the yearly precipitation is less than the potential water loss by evaporation.

ii. To define the boundary between dry and humid climates, the Köppen classification uses formulas that involve three variables: (1) average annual precipitation, (2) average annual temperature, and (3) seasonal distribution of precipitation.

iii. The two climatic regions defined by a general water deficiency are arid or **desert (BW)**, and **semiarid or steppe (BS)**. The differences between deserts and steppes are primarily a matter of degree.

1. Semiarid climates are a marginal and more humid variant of arid climates that represent transitional zones that surround deserts and separate them from the bordering humid climates.

2. Under the strong influence of the subtropical highs, the heart of the subtropical desert (BWh) and steppe (BSh) climates lies in the vicinity of the Tropic of Cancer and the Tropic of Capricorn.
   a. Within subtropical deserts, the scanty precipitation is both infrequent and erratic.
   b. In the semiarid transitional belts surrounding the desert, a seasonal rainfall pattern becomes better defined. Due to cloudless skies and low humidities, low-latitude deserts in the interiors of continents have the greatest daily temperature ranges on Earth.
   c. Where subtropical deserts are found along the west coasts of continents, cold ocean currents produce cool, humid places, often shrouded by low clouds or fog. Unlike their low-latitude counterparts, middle-latitude deserts (BWk) and steppes (BSk) are not controlled by the subsiding air masses of the subtropical highs. Instead, these lands exist principally because of their position in the deep interiors of large landmasses.

**Humid Climates (C)**

i. **Humid middle-latitude climates with mild winters** (C climates) occur where the average temperature of the coldest month is less than 18°C (64°F) but above –3°C (27°F). Several C climate subgroups exist.

1. **Humid subtropical climates** (Cfa) are on the eastern sides of the continents, in the 25- to 40-degree latitude range. Because of the dominating influence of maritime tropical air masses, summer weather within these regions is hot and sultry, and winters are mild.

2. In North America, the **marine west coast climate** (Cfb) extends from near the United States–Canada border northward as a narrow belt into southern Alaska. The prevalence of maritime air masses means mild winters, cool summers, and ample rainfall throughout the year.

3. **Dry-summer subtropical (Mediterranean) climates** (Csa, Csb) are typically found along the west sides of continents between latitudes 30 and 45°. In summer, the regions are dominated by the stable eastern sides of the oceanic subtropical highs. In winter, as the wind and pressure systems follow the Sun equatorward, they are within range of the cyclonic storms of the polar front.

ii. **Humid continental climates with severe winters** (D climates) experience severe winters. The average temperature of the coldest month is –3°C (27°F) or below, and the average temperature of the warmest month exceeds 10°C (50°F).

1. **Humid continental climates** (Dfa) are land controlled that do not occur in the Southern Hemisphere. They are confined to central and eastern North America and Eurasia in the latitude range 40 to 50°N. Both winter and summer temperatures in Dfa climates can be characterized as severe and annual temperature ranges are large. Precipitation is generally
greater in summer and generally decreases toward the continental interior and from south to north. Wintertime precipitation is chiefly associated with the passage of fronts connected with traveling middle-latitude cyclones.

2. **Subarctic climates** (Dfc, Dfd), often called *taiga climates* because they correspond to the northern coniferous forests of the same name, are situated north of the humid continental climates and south of the polar tundras. The outstanding feature of subarctic climates is the dominance of winter. By contrast, summers in the subarctic are remarkably warm, despite their short duration. The greatest annual temperature ranges on Earth occur here.

d. **Polar climates** (ET, EF) are those in which:
   i. The mean temperature of the warmest month is below 10°C (50°F).
   ii. Annual temperature ranges are extreme, with the lowest annual means on the planet. Although polar climates are classified as humid, precipitation is generally meager, with many nonmarine stations receiving less than 25 centimeters (10 inches) annually.
   iii. Two types of polar climates are recognized.
      1. Found almost exclusively in North America, the *tundra climate* (ET), marked by the 10°C (50°F) summer isotherm at its equatorward limit, is a treeless region of grasses, sedges, mosses, and lichens with permanently frozen subsoil, called *permafrost*.
      2. The *ice cap climate* (EF) does not have a single monthly mean above 0°C. Consequently, the growth of vegetation is prohibited, and the landscape is one of permanent ice and snow.

3. **Highland climates** are characterized by a great diversity of climatic conditions over a small area. In North America, highland climates characterize the Rockies, Sierra Nevada, Cascades, and the mountains and interior plateaus of Mexico. Although the best-known climatic effects of an increased altitude are lower temperatures, greater precipitation due to orographic lifting is also common. Variety and changeability best describe highland climates. Because atmospheric conditions fluctuate with altitude and exposure to the Sun's rays, a nearly limitless variety of local climates occur in mountainous regions.