Tropical Climates

These climates are usually found within 15° of the equator and are characterized by hot temperatures throughout the year. In *tropical wet* climates, significant amounts of precipitation occur throughout the year, while in *tropical wet-dry* climates, a distinct dry season can be recognized. Monsoon climates can be included in this latter subdivision.

Desert Climates

Where precipitation is extremely limited, desert conditions occur. *Hot weather deserts* such as the Sahara can be easily distinguished from *cold weather deserts* found in high latitudes. Specific climatic factors can give rise to desert conditions in various world locations. Cold ocean currents flowing along the western edges of the Americas and Africa combine with very stable air to produce *west-coast deserts* such as the Atacama in Peru and the Namib in Namibia and Angola. Rainshadow areas on the leeward side of many of the world's great mountain ranges can result in desert conditions.

Mid-latitude Climates

Great variety highlights mid-latitude climates. Warm, dry summers and cool, wet winters are characteristic of *Mediterranean climates* which occur in the Mediterranean, California, Chile, South Africa, and parts of western Australia. *West-coast climates* are found in areas on the windward side of mountain ranges and are characterized by heavy amounts of precipitation and moderate temperatures throughout the year. On the leeward side of these mountain ranges, drier climates called *mid-latitude steppe* can be found. These climates usually experience a large range of temperatures between winter and summer. *Humid subtropical climates* generally experience rainfall throughout the year. They experience warm to hot summers and cool winters. They are most often found on the southeastern sides of the continents. *Humid continental climates* are similar to humid subtropical climates but are found farther north and, therefore, experience more severe winters with significant snowfall amounts. Cold winters and warm summers with precipitation throughout the year characterize humid continental climates.

High Latitude Climates

Because of their extreme latitudes, these climates are characterized by extremely cold winters and short, cool summers. *Continental/subarctic/climate* areas experience very cold, long winters and receive a minimal amount of precipitation. *Marine subarctic climates* are noted for their wet, windy conditions. They experience milder winters and more precipitation than their continental subarctic cousins. True *Arctic climates* are found north of 70° and are so cold they experience no real summer. They are also very dry and in most areas can be classified as cold weather deserts.

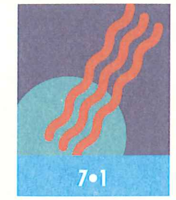
Highland Climates

Variations in altitude can result in all the above climates being experienced on a single mountain near the equator. Great differences over short distances are characteristic of *highland climates* and, therefore, it is very difficult to accurately classify the climates of mountainous areas.

QUESTIONS

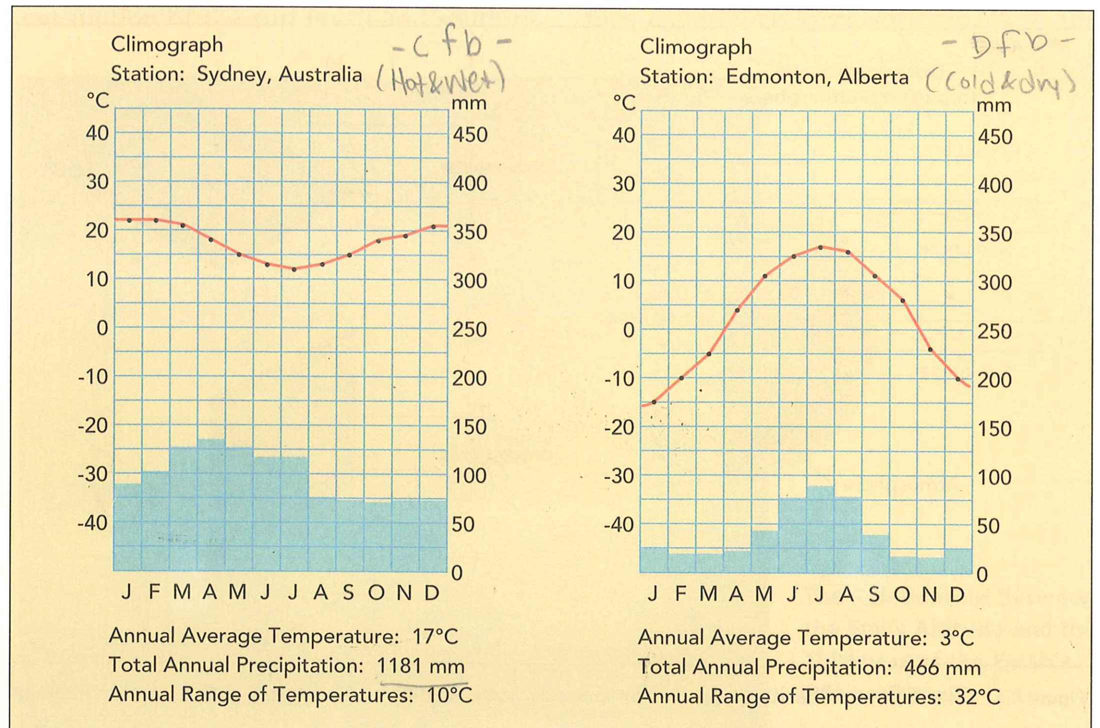
1. List what you consider to be three advantages and three disadvantages of the climate experienced in the area in which you live.
2. Figures 8.4 and 8.5 display climatic data for four world locations. Figure 8.4 shows two **climographs**, while Figure 8.5 shows two **hythergraphs**. For each location, choose two different classification systems (Figures 8.1 through 8.3) and classify the climate at that location according to the climatic classification system being used.
3. Compare climographs and hythergraphs. What are the advantages and disadvantages of each of these methods used to display climatic data?
4. Why would the study of world climates be complicated if we did not classify the climates in various ways?
5. Identify three ways in which the climate of your area influences the economic activities found there.

8•3 Climatic Controls: The Variations in Solar Radiation Inputs



The nature and importance of solar radiation were considered in Chapter 7. The amount of solar radiation available for use at the earth's surface varies greatly from location to location and from season to season. These variations lead to dramatic differences in world climates. An important factor that contributes to variations in solar radiation is the latitude of places on the earth's surface.

Due to the curvature of the earth, solar radiation received at higher latitudes is less intense than at the equator. This is because the same amount of solar radiation is spread out over an ever greater area of the earth's surface, as Figure 8.6 illustrates.



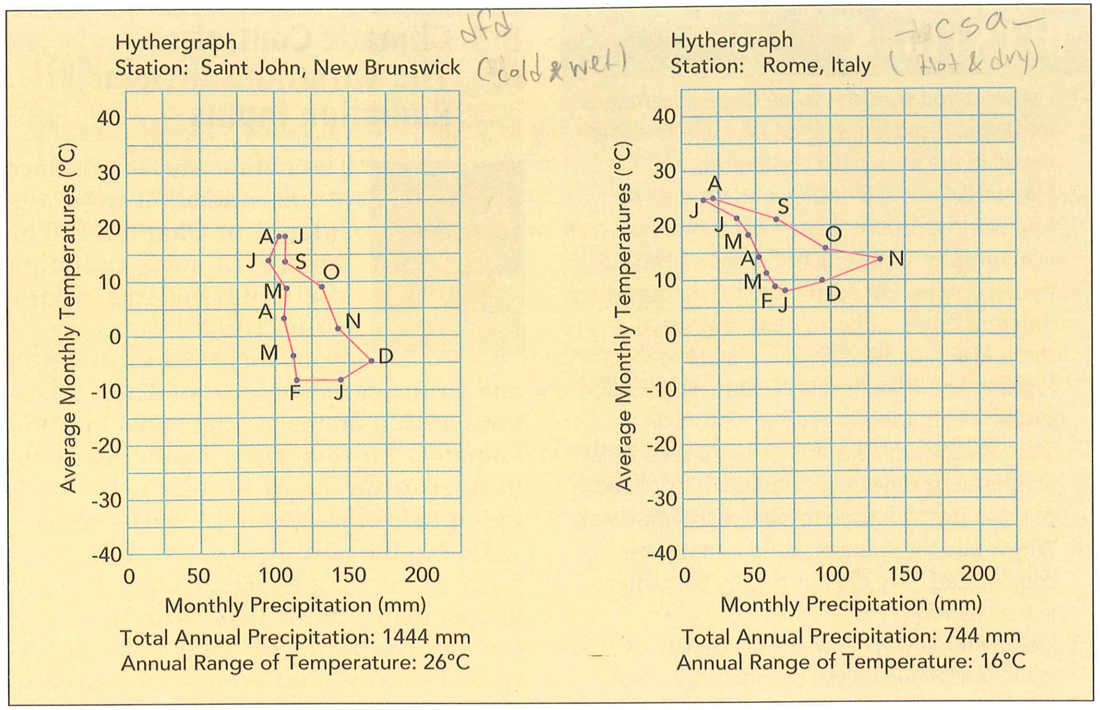


Figure 8.5 **Hythergraphs of Saint John, New Brunswick, and Rome, Italy**

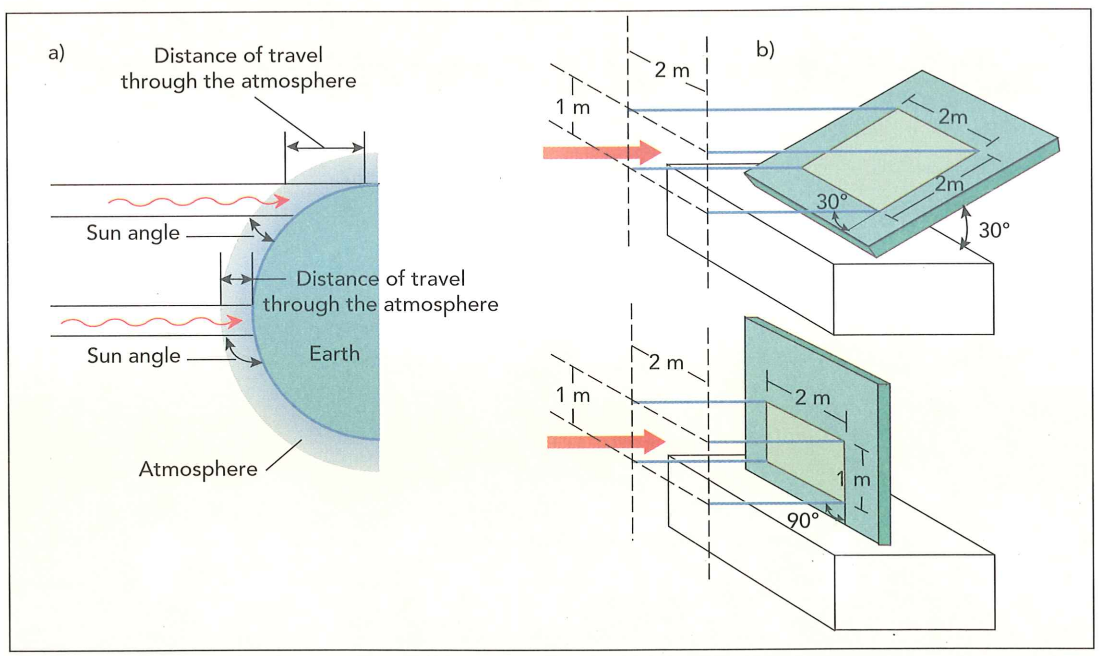


Figure 8.6 **The Effect of Latitude on the Amount of Solar Radiation Received at the Earth's Surface**

As a result, temperatures and evaporation rates usually decrease as latitude increases. Other factors come into play as well. The angle of the incoming solar radiation becomes more oblique at higher latitudes, and so albedo values tend to increase. In addition, Figure 8.6 illustrates that as you move away from the equator, the thickness of the atmosphere through which solar radiation must pass increases. This leads to more absorption, scattering, and reflection of solar radiation at these latitudes, which further reduces the amount of incoming solar radiation received at higher latitudes. Figure 8.7 illustrates the relationship between the sun's altitude, the thickness of the atmosphere through which solar radiation must pass, and the intensity of solar radiation that would be received at the earth's surface.

The variation in the amount of incoming solar radiation caused by the apparent motion of the sun north and south of the equator is also a significant factor in explaining the differences in climates experienced on earth. On June 21, the sun is directly overhead on the Tropic of Cancer, 23.5°N. The northern hemisphere is experiencing summer, characterized by warm temperatures and long days. On December 21, the sun is directly overhead on the Tropic of Capricorn, 23.5°S. The southern hemisphere at this time is experiencing summer, while winter is beginning in the north. Figure 8.8 illustrates the variation in the length of day and thus in incoming solar radiation for the northern hemisphere. Remember, however, as you study Figure 8.8 that the amount of net radiation available for use at the earth's surface is not simply a function of the number of daylight hours.

As a result of the latitude and the season of the year, places on the earth's surface experience great differences in the

Sun's Altitude	Distances Rays Must Travel Through Atmosphere*	Radiation Intensity on a Surface Perpendicular to Rays	Radiation Intensity on a Horizontal Surface
90	1.00	78	78
80	1.02	77	76
70	1.06	76	72
60	1.15	75	65
50	1.31	72	55
40	1.56	68	44
30	2.00	62	31
20	2.92	51	17
10	5.70	31	5
5	10.80	15	1
0	45.00	0	0

* Expressed in atmospheres where 1.00 is the thickness of the atmosphere when the sun is directly overhead. A Transmission Coefficient of 78 percent is used. This means that it is assumed that 78 percent of the radiation entering the earth's atmosphere will reach the planet's surface.

Figure 8.7 **The Relationship Between the Sun's Altitude and the Thickness of the Earth's Atmosphere**

	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
Jan.	12:07	11:35	11:02	10:24	9:37	8:30	6:38	0:00	0:00	0:00
Feb.	12:07	11:49	11:21	11:10	10:42	10:07	9:11	7:20	0:00	0:00
Mar.	12:07	12:04	12:00	11:57	11:53	11:48	11:41	11:28	10:52	0:00
Apr.	12:07	12:21	12:36	12:53	13:14	13:44	14:31	16:06	24:00	24:00
May	12:07	12:34	13:04	13:38	14:22	15:22	17:04	22:13	24:00	24:00
June	12:07	12:42	13:20	14:04	15:00	16:21	18:49	24:00	24:00	24:00
July	12:07	12:40	13:16	13:56	14:49	15:38	17:31	24:00	24:00	24:00
Aug.	12:07	12:28	12:50	13:16	13:48	14:33	15:46	18:26	24:00	24:00
Sept.	12:07	12:12	12:17	12:23	12:31	12:42	13:00	13:34	15:16	24:00
Oct.	12:07	11:55	11:42	11:28	11:10	10:47	10:11	9:03	5:10	0:00
Nov.	12:07	11:40	11:12	10:40	10:01	9:06	7:37	3:06	0:00	0:00
Dec.	12:07	11:32	10:56	10:14	9:20	8:05	5:54	0:00	0:00	0:00

Figure 8.8 Hours and Minutes of Sunlight Experienced on the 15th of Each Month vs. Degrees of Latitude in the Northern Hemisphere

amount of solar radiation received. These differences in turn directly affect the climates experienced on earth. Figure 8.9 summarizes and illustrates the variations in the amount of solar radiation received at the earth's surface. In general, the solar radiation values decrease from the equatorial regions to the poles. However, the pattern is complex due to factors such as albedo and cloud cover that can distort the expected pattern.

The major climatic effects of these variations in the amount of incoming solar radiation are felt in the areas of temperature, air pressures, and wind and ocean currents. Figure 8.10 illustrates the effect that latitude has on temperatures. The imbalance in heat that exists between latitudinal zones is responsible for triggering global winds and ocean currents.

QUESTIONS

6. Imagine living above the Arctic Circle and experiencing 24 hours of daylight in the summer and 24 hours of darkness in the winter. What would be five advantages and five disadvantages of these unusual days and nights?
7. Figure 8.8 indicates that, during the northern summer, locations above the Arctic Circle (66.5°N) experience 24 hours of daylight. What factors reduce the impact or effectiveness of this constant supply of solar radiation?
8. Using columns 3 and 4 of Figure 8.7, draw a diagram that illustrates the difference between radiation intensity on a surface perpendicular to the sun's rays as opposed to the radiation intensity on a surface horizontal to the earth.
9. How would the pattern of solar radiation received at the earth's surface (Figure 8.9) be altered if the earth were a cube instead of a sphere? Redraw Figure 8.6 to illustrate your answer.

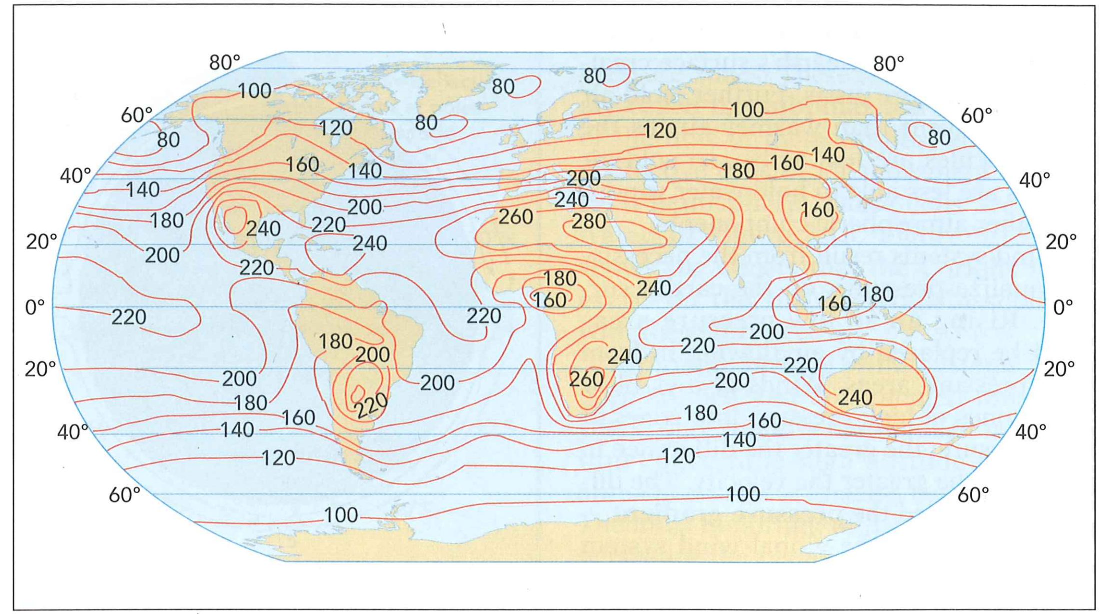


Figure 8.9 Solar Radiation Amounts Across the Globe Highly generalized map of mean annual solar radiation received at the earth's surface. Units are watts per square metre.

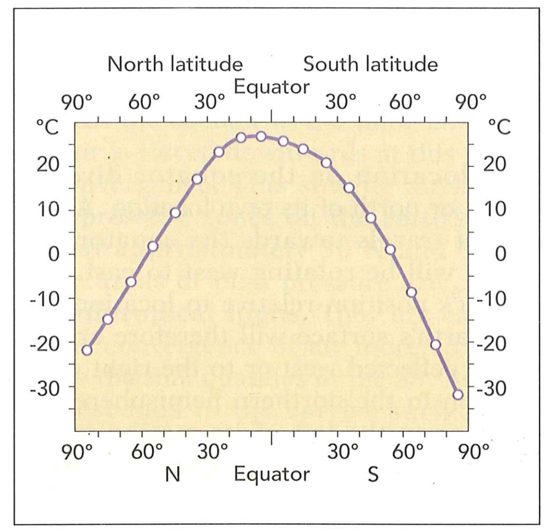


Figure 8.10 Mean Surface Air Temperature by Latitude Zones

8•4 Climatic Controls: The Global Wind Systems

A second global influence on climate is the earth's wind systems.

Hot air is less dense than cool air. This is due to the activity of the air molecules themselves. As heat is introduced into an air mass, the air molecules absorb energy and their activity or movement increases, leading to fewer air molecules per unit volume of atmosphere. Less dense, warm air tends to rise. This is why a hot air balloon rises. In addition, hot or warm air is buoyant; this means that because of the increased molecular activity, the air is able to support or hold a greater amount of other atmospheric components, such as water vapour. Areas of warm, rising air have low atmospheric pressures.

By contrast, the number of air molecules per unit volume of atmosphere in cold air is greater. This leads to heavier or more