

within maritime tropical air masses and produce scattered thunderstorms on summer days. Such storms are usually short-lived and seldom produce strong winds or hail.

Another type of thunderstorm not only benefits from uneven surface heating but is associated with the lifting of warm air, as occurs along a front or a mountain slope. Moreover, diverging winds aloft frequently contribute to the formation of these storms because they tend to draw air from lower levels upward beneath them. Some of the thunderstorms of this type may produce high winds, damaging hail, flash floods, and tornadoes. Such storms are described as *severe*.

At any given time, an estimated 2000 thunderstorms are in progress on Earth. As we would expect, the greatest number occur in the tropics, where warmth, plentiful moisture and instability are always present. About 45,000 thunderstorms take place each day, and more than 16 million occur annually around the world. The lightning from these storms strikes Earth 100 times each second (FIGURE 14.13A). Annually, the United States experiences about 100,000 thunderstorms and millions of lightning strikes. A glance at FIGURE 14.13B shows that thunderstorms are most frequent in Florida and the eastern Gulf Coast region, where such activity is recorded between 70 and 100 days each year. The region on the east side of the Rockies in Colorado and New Mexico is next, with

DID YOU KNOW?

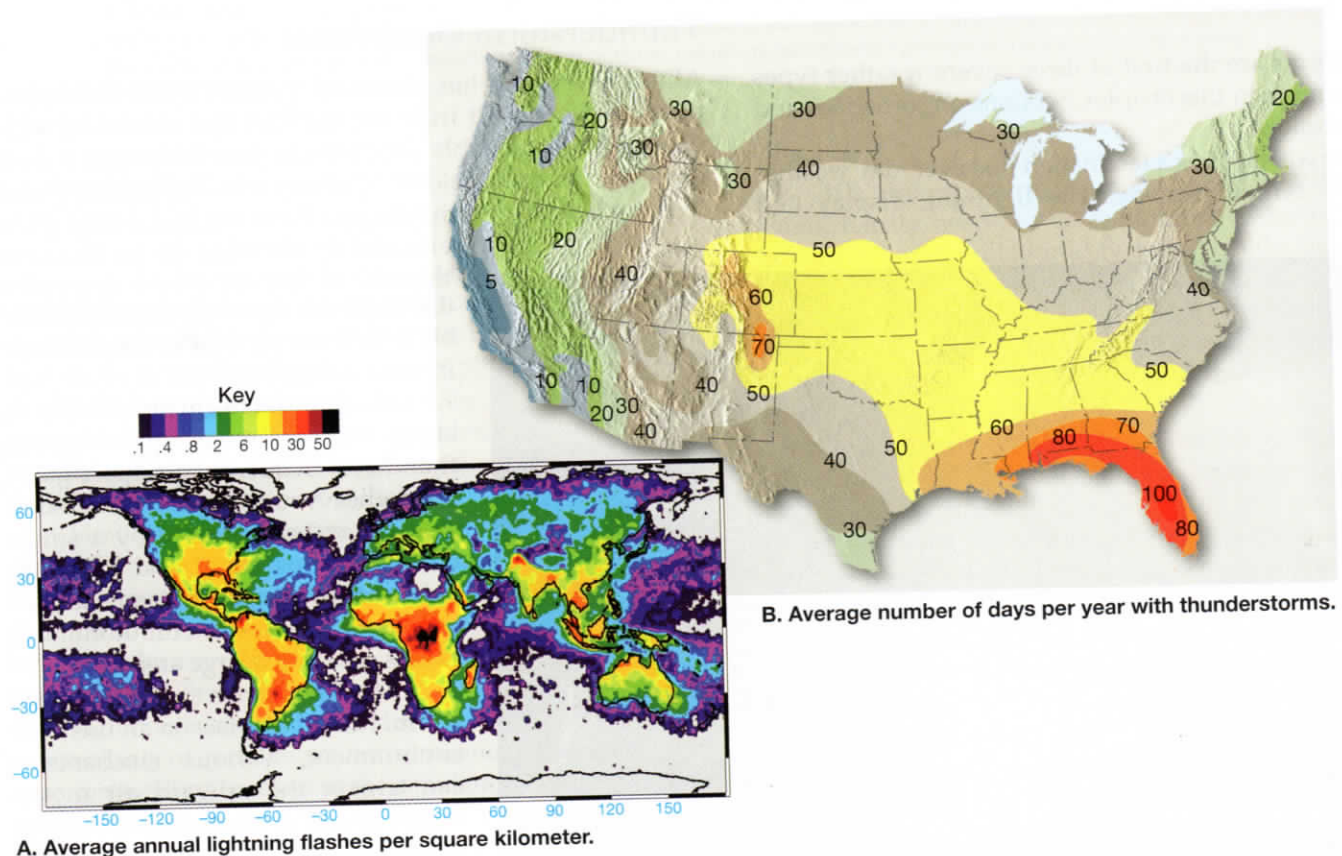
Because lightning and thunder occur simultaneously,

for you to estimate how far away a lightning stroke occurred. *Lightning is seen instantaneously, but sound travels more slowly (about 1000 ft per sec) and reaches us later. If thunder is heard five seconds after lightning is seen, the lightning occurred about 5000 ft (1 mi) away.*

thunderstorms occurring on 60 to 70 days each year. The rest of the nation experiences thunderstorms on 30 to 50 days annually. Clearly, the western margin of the United States has little thunderstorm activity. The same is true of the northern tier of states and for Canada, where warm, unstable mT air seldom penetrates.

Stages of Thunderstorm Development

All thunderstorms require warm, moist air, which, when lifted, will release sufficient latent heat to provide the energy necessary to maintain its upward flight. This ins



A. Average annual lightning flashes per square kilometer.

B. Average number of days per year with thunderstorms.

FIGURE 14.13 A. Data from space-based optical sensors show the worldwide distribution of lightning, with color variations indicating the average annual number of lightning flashes per square kilometer. The map includes data obtained from April 1995 to March 2000 from NASA's Optical Transient Detector, and from December 1997 to November 2000 from NASA's Lightning Imaging Sensor. Both are satellite-based sensors that use high-speed cameras capable of detecting brief lightning flashes even under daytime conditions. (NASA) B. Average number of days each year with thunderstorms. The humid subtropical climate that dominates the southeastern United States receives much of its precipitation in the form of thunderstorms. Most of the Southeast averages 50 or more days each year with thunderstorms. (Environmental Data Service, NOAA)