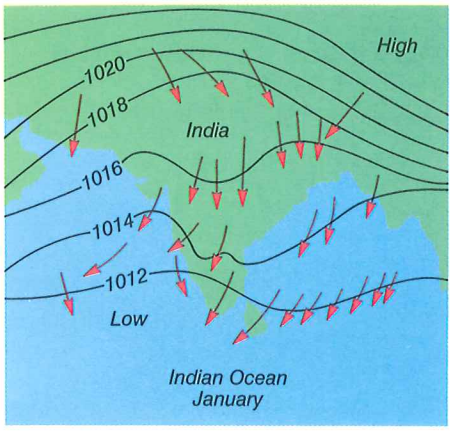
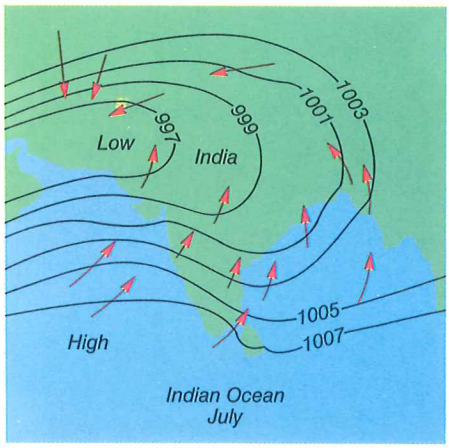
28.14 (top) India's dry winter monsoon blows from the land to the sea. (bottom) The wet summer monsoon blows from the sea to the land.





28.15 A typical position of the Northern Hemisphere jet stream over North America

Topic 16 Monsoons

The most dramatic continental effects on wind and pressure occur on the Indian subcontinent. Here the seasonal pressure changes from the heating and cooling of Asia produce a complete wind reversal. During the winter the sinking, cold air over the continent flows toward the lower pressure over the sea. In summer, the low pressure areas over the Indian subcontinent and Southeast Asia become centers of rising warm, moist air from the surrounding waters.

The changing winds are called **monsoons**. The cold, dry winds that flow from the cold interior are the winter monsoon. The warm, moist winds that flow into Asia from the Indian Ocean are called the summer monsoon. When they rise over the highlands of India and Southeast Asia, heavy rains fall.

Other parts of the world, such as northern Australia, west-central Africa, Spain, and the southeastern and southwestern United States, have seasonal wind changes. In most cases, however, the winds do not turn around as strongly as in India.

Topic 17 Jet Streams

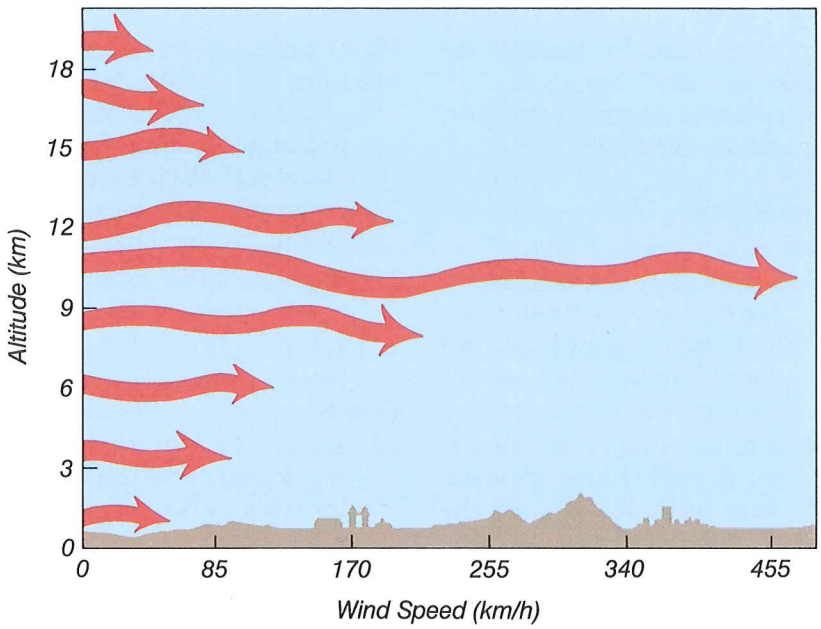
Wind speeds are very high in the upper troposphere. It is here that the spectacular jet stream is found. **Jet streams** are a fairly narrow zone of very strong winds in the upper troposphere. Jet streams are most common in the middle latitudes, so the winds in the jet streams are usually from the west. Sometimes it forms a single meandering band around the entire Earth. More often it is made of two or more separate streams.

The height of jet streams ranges from about 6000 to 12 000 meters. Its strongest winds are about 10 500 meters above Earth. Its separate streams may be from 1600 to 4000 kilometers long, about one tenth as wide, and about 1 kilometer thick. Wind speeds are usually about 150 knots, but they may exceed 300 knots.

Two or more jet streams may be over a continent at once. In the Northern Hemisphere upper-air westerlies, jet streams may reach as far south as 20° N. The jet stream shifts position with the season, moving north in summer and south in winter. Its most common location over North America is around 40° N. A jet stream called the tropical easterly jet forms in the tropics in the Northern Hemisphere summer, but is weaker than the jet stream of the latitudes farther north. Figure 28.15 shows a typical position of the jet stream over North America.

Jet streams help eastward-flying planes to fly faster relative to the ground. Aircraft flying westward are slowed down by the jet streams, so pilots try to avoid them.

Jet streams are closely related to the weather and are strongest during outbreaks of cold polar air. Spring and summer jet streams are related to strong thunderstorms.



28.16 The arrows show wind speeds above the surface on a winter day in central United States. The very long arrow at about 10.5 kilometers is the jet stream. Its maximum speed is about 400 kilometers per hour.

TOPIC QUESTIONS

Each topic question refers to the topic of the same number.

15. **(a)** How do Earth's continents affect Earth's wind and pressure belts? **(b)** Why does the ITCZ move so far from the equator into the hemisphere where it is summer? **(c)** Describe the pressure pattern around North America for the Northern Hemisphere summer.

16. **(a)** What are monsoons? **(b)** Describe the summer and winter Indian monsoons.

17. **(a)** What are jet streams? **(b)** List the height, location, and wind speeds of the North-American jet stream. **(c)** How is the jet stream related to the weather at the ground?

Map Skills

The following questions refer to the Prevailing World Winds map on page 659 of Appendix B.

1. **(a)** In the Southern Hemisphere, from what direction do the winds near the equator blow? **(b)** From what direction do the winds south of 40°S blow?

2. How are the winds in the Northern Hemisphere different from those in the Southern Hemisphere?

3. What happens to the southeast trade winds to the south of North Africa and Asia?