II Cyclonic Storms

Topic 6 Hurricanes

People living along the Gulf and Atlantic coasts pay careful attention to weather reports of hurricanes. A **hurricane** is an intense tropical low-pressure area with sustained winds of 120 kilometers per hour or greater. The strong winds and heavy rains produce major damage.

The greatest damage associated with hurricanes is caused by currents called **storm surges.** A storm surge forms when the hurricane piles up water along the shore and then blows it inland. Storm surges are much more damaging during high tide. In May 1991, a tropical cyclone produced a 20-foot storm surge in Bangladesh. It caused 139 000 deaths and left 9 million homeless.

Hurricanes are in some ways like mid-latitude cyclones. They both are low-pressure areas. Winds spiral toward their centers in the same general patterns. As a rule both have areas of heavy precipitation, and both grow larger and more powerful from the vast amounts of energy released in them by condensing water vapor.

In other ways, though, hurricanes are different from mid-latitude lows. A low forms and grows along fronts and gets energy from the air-mass contrast across the fronts. A hurricane has no fronts. Unlike the mid-latitude low, it has a central area of sinking air, known as the **eye** of the storm. The eye is usually 15 to 50 kilometers in diameter. The only clouds in the eye are stratocumulus at low levels and, sometimes, some cirrus at high levels. Because the air in the eye is sinking, there is no rain. There is almost no wind. The eye is surrounded by intense thunderstorms called the *eye wall.* Hurricanes have average diameters of 300 to 600 kilometers, smaller than a mid-latitude low. Finally, hurricanes are by definition intense. Their central pressures are lower and their wind speeds are larger than those of typical mid-latitude lows.

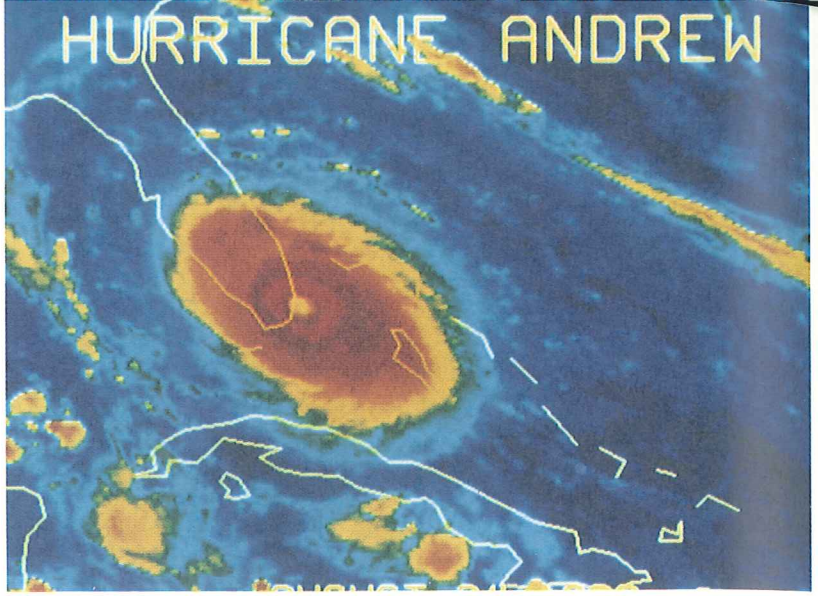
The winds increase toward the center of the hurricane and are most violent just outside the eye. Here, wind speeds may be greater than 240 kilometers an hour. The area of destructive winds may be as large as 800 kilometers across and 1600 kilometers long. Tornadoes and severe thunderstorms often occur as hurricanes come ashore. Like the wind, the rainfall increases toward the center of the storm. It is heaviest just outside the eye.

In 1992, the eye of Hurricane Andrew crossed Florida south of Miami. Sustained winds of over 225 kilometer's cut a 45-kilometer swathe of destruction across South Florida. The storm splintered houses, toppled trees, and flattened cars as shown in Figure 30.7. Andrew's storm surge reached 17 feet near Florida. Andrew then crossed the Gulf of Mexico and hit Louisiana. Over 100 000 people were left homeless. Timely hurricane warnings and the evacuation of residents kept the number of deaths to less than 40.

OBJECTIVES

- **A** Describe hurricanes and their life cycle.
- **B** Explain how hurricanes produce their damage.
- **C** Show how the Weather Service tracks hurricanes and differentiate between hurricane watches and warnings.
- **D** Specify the conditions necessary to produce a heavy snowfall.

30.5 The 1985 hurricane Elena, photographed from the space shuttle. Notice the cloud spiraling around the eye at the center.



30.6 Radar image of Hurricane Andrew as it approached South Florida.

HURRICANE SAFETY TIPS

1. ***When a Hurricane Watch Is Issued.*** *Stay tuned to radio, TV, or NOAA Weather Radio. Secure your home—check mobile home tie-downs; tape, board, or shutter windows; wedge sliding doors shut; bring lawn furniture and other loose items inside; check batteries in radio and flashlights; stock up on canned food and medicines. Moor small boats or put them in a shelter.*
2. ***When a Hurricane Warning Is Issued.*** *Stay tuned to radio, TV, or NOAA Weather Radio.*
   - *In case of evacuation or if you live in a mobile home: Leave as early as possible for nearest designated shelter. Shut off water and electricity, leave food and water for pets (shelters will not take them).*
   - *If evacuation is not recommended and house is sturdy and on high ground: Board up garage and porch doors; fill containers (bathtubs) with several days supply of drinking water; turn up refrigerator to coldest setting, and don't open it unless necessary. Use phone only for emergencies.*
3. ***When the Hurricane Hits.*** *Stay indoors, away from windows.*
4. ***After the Storm.*** *Watch for downed electrical wires, unsafe roads, flooded areas. Report damaged water, sewer, or electrical lines. Use caution when entering a building. Check for gas leaks.*

Topic 7 Sources and Tracks of Tropical Storms

Tropical storms form from tropical lows along the intertropical convergence zone (ITCZ). They get their energy from the heat and water vapor from the sea surface and from the release of heat by condensing water vapor. The strengthening storms usually move westward at about 10 to 20 kilometers an hour. If they move northward through the horse latitudes into the westerlies, they begin to travel eastward. Here, the hurricanes, also known as *Tropical Cyclones* and *Typhoons,* speed up and usually weaken as they encounter colder water. Cooler water supplies the storm with less heat and moisture. Also, cumulonimbus clouds do not grow as deep over cooler surfaces. Hurricanes also weaken when they move over land.

Many of the Atlantic hurricanes that affect the United States start as lows as far away as West Africa. The lows grow into hurricanes when they reach the warm waters of the western Atlantic, the Caribbean, or the Gulf of Mexico.

Before the days of satellites, North America's Pacific hurricanes were thought to be rare. However, eastern Pacific hurricanes are actually more common than the Atlantic ones. Pacific hurricanes form to the west of Mexico and mostly move westward. Occasionally they move as far north as California or as far west as Hawaii, as Hurricane Iniki did in 1992.

Hurricanes are most common in the late summer and early fall in the northern hemisphere because the ITCZ is farther north and the sea surface temperatures are warm. Tropical cyclones are most common in the winter and early spring in the southern hemisphere.

Topic 8 Naming and Forecasting Hurricanes

Before 1953, hurricanes were identified only by their dates. From 1953 to 1979, hurricanes were identified by giving them female

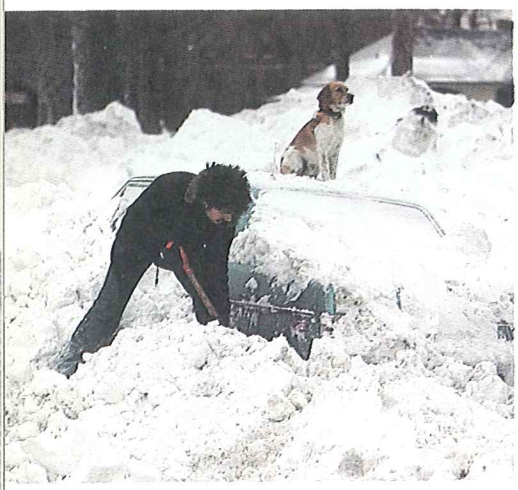
30.7 Widespread damage from Hurricane Andrew in South Florida.

names. In 1979, however, the National Weather Service began the present practice of using male names too. Two sets of six lists were prepared—one set for Atlantic hurricanes and the other for eastern Pacific hurricanes. Each set was to be used for six years from 1979–1984 and then repeated in each six-year cycle thereafter. If a particular hurricane is an exceptional one, its name will be retired and a new name substituted. Names are arranged alphabetically, with male and female names alternating. A storm is named once it reaches tropical storm status (sustained winds of 65 kilometers per hour or greater).

Early hurricane forecasts are important in protecting life and property. Several techniques are used to keep close watch on each hurricane and tropical storm as it grows and moves. Weather satellites are used to track hurricanes and estimate their strength and to spot new storms. Weather reconnaissance aircraft fly through hurricanes for direct measurements of storm strength. Also, when the hurricane is within a few hundred kilometers of a radar, the radar can be used to watch the hurricane.

Hurricane watches and warnings are issued by the National Hurricane Center in Miami, Florida. A warning means that hurricane conditions are expected within 24 hours. A 24-hour warning allows communities in the path of the hurricane to take precautions against potential damage from strong winds and floods.

Evacuation of areas threatened by major hurricanes has kept the number of deaths low. However, meteorologists think this is partially luck. The population has increased so much in some beachfront areas that it is nearly impossible to evacuate everyone in time to avoid a major storm.



30.8 A major snowstorm creates work for many people.

Topic 9 Winter Storms

Strong mid-latitude lows bring the winter's major snowstorms. However, two conditions must be met. First, there must be enough moisture. Second, the temperature must be cold enough for snow.

Mid-latitude lows are strongest in winter along the east coast, and strongest in spring over the continental United States. Lows form and grow along the polar front. Strong lows form when the polar front is strong. The polar front is the strongest when the contrast between air masses is strongest.

Strong mid-latitude lows have minimum pressures around 980 millibars, with some stronger lows having pressures as low as 940 millibars. Since wintertime highs are also stronger, large pressure gradients and strong winds result.

A snowstorm with high winds and low temperatures is called a **blizzard.** The National Weather Service issues winter storm watches and warnings. The definition of winter storm varies with location.

The moisture supply for winter storms differs in different parts of the country. In the midwestern United States, much of the moisture comes from the Gulf of Mexico. To the west, on the Great Plains, water vapor from earlier snowfalls becomes more important. On the East Coast, there is ample moisture over the Atlantic. The West Coast storms are fed by moist air from the Pacific. In the winter, mountains get deep snows as moist air is forced upward on their windward sides.

A temperature difference of a few degrees can be the difference between heavy snow, mixed rain and snow, freezing rain, or rain. For this reason, predicting the amount and type of precipitation expected with a storm is difficult.

TOPIC QUESTIONS

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

6. **(a)** What is a hurricane? How does it cause damage? **(b)** How are hurricanes and mid-latitude lows alike? How are hurricanes and mid-latitude lows different?

7. **(a)** Where and how do tropical storms form? **(b)** Describe the path of a hurricane, from its origin as a low-pressure area to its death. **(c)** When is the best time for Atlantic hurricanes to form? Why?

8. **(a)** How do meteorologists trace the path and strength of a hurricane? **(b)** What is the difference between a hurricane watch and a hurricane warning?

9. List the conditions necessary to produce a heavy snowfall.