

## Section 2

# Currents and Climate

**Key Concept** Ocean currents transport energy, affect climate and weather, and distribute nutrients.

### What You Will Learn

- Surface currents affect climate by distributing energy around Earth.
- Changes in surface currents, such as El Niño, can cause changes in weather patterns.

### Why It Matters

Surface currents affect the climate of many of the most populated areas of the world.

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The Scilly Isles in Great Britain are located as far north as Newfoundland in Canada. But the Scilly Isles have warm weather almost all year long, and Newfoundland has long winters of frost and snow. How can two places at similar latitudes have such different climates? This difference in climate happens because heat is transported by the Gulf Stream.

## Surface Currents and Climate

Surface currents greatly affect the climate in many parts of the world. The surface temperature of the water affects the temperature of the air above it. Warm currents heat air and cause warmer air temperatures. Cold currents absorb energy from surrounding air and cause cooler air temperatures. Also, water absorbs and releases heat more slowly than land does. So, sudden changes and extreme temperatures are unusual on land near any large body of water.

### Warm-Water Currents and Climate

Surface currents are often warmer than deep currents, but the temperatures of surface currents do vary. Coastal areas that are affected by warm-water currents tend to have warmer climates than inland areas of the same latitude have. **Figure 1** shows the Gulf Stream as it carries heat from the Tropics northward. The heat is absorbed by the atmosphere around Great Britain. As a result, Great Britain has a mild climate for land at such a high latitude. Because of the Gulf Stream, the Scilly Islands have a milder climate than Newfoundland has.

### Figure 1 How Warm-Water Currents Affect Climate

**1** The Gulf Stream carries warm water from the Tropics to the North Atlantic Ocean.

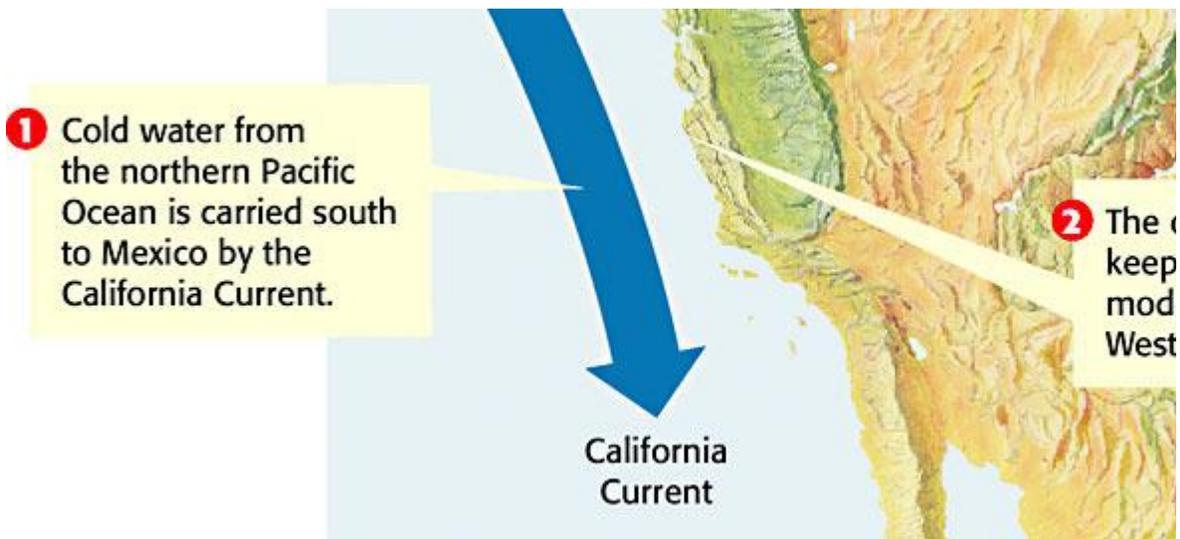


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### Cold-Water Currents and Climate

Coastal areas near cold-water currents feel the effects of the cold water on their climates. **Figure 2** shows how the California Current carries cold water south from the North Pacific Ocean. The California Current moves less water than the Gulf Stream does. But the California Current has a big effect on the climate of the West Coast of the United States. Summer temperatures differ less from winter temperatures along the West Coast than they do inland. Usually, the climate along the West Coast is cooler than the climate of inland areas at the same latitude and elevation.

**Figure 2 How Cold-Water Currents Affect Climate**



**Standards Check** How do ocean currents affect climates?



### El Niño and La Niña

Every 2 to 12 years, the South Pacific trade winds move less warm water to the western Pacific than they usually do. Thus, surface-water temperatures along the coast of South America rise. Gradually, this warming spreads westward. This periodic change in the location of warm and cool surface waters in the Pacific Ocean is called **El Niño**. El Niño can last for a year or longer. Sometimes, El Niño is followed by La Niña. **La Niña** is a periodic change in the eastern Pacific Ocean in which the surface-water temperature becomes unusually cool.

### El Niño and Weather Patterns

Both El Niño and La Niña change the way the ocean and atmosphere interact. The resulting changes in the circulation of the atmosphere lead to changes in global weather patterns. Changes in the weather during El Niño show how the atmosphere, ocean, and weather patterns are related. Scientists can predict the weather changes on land that might be caused by El Niño by studying the atmosphere and ocean.



### Studying and Predicting El Niño

Because El Niño occurs every 2 to 12 years, studying and predicting this phenomenon can be difficult. However, it is important for scientists to learn as much as possible about El Niño because of its effects on organisms and land.

One way scientists collect data to predict El Niño is through a network of buoys anchored to the ocean floor along Earth's equator. The buoys record data about water temperature, air temperature, currents, and winds. Buoys sometimes report that the South Pacific trade winds are weaker than usual. Or buoys may report that the surface temperatures of the tropical oceans have risen. If either of these changes happen, scientists can predict that El Niño is likely to occur.

### Effects of El Niño

El Niño can alter weather patterns enough to cause disasters in many parts of the world. For example, flash floods and mudslides may happen in areas of the world that usually receive little rain. These areas include Peru and the southern half of the United States. **Figure 3** shows homes that were destroyed by a mudslide that happened during an El Niño event.



**Figure 3** This damage in Southern California was the result of excessive rain that occurred during an El Niño event in 1997.

While some regions flood, regions that usually get a lot of rain may experience droughts. *Droughts* are unusually long periods during which rainfall is below average. Periods of severe drought can lead to crop failure. During El Niño, severe droughts can occur in Indonesia and Australia.

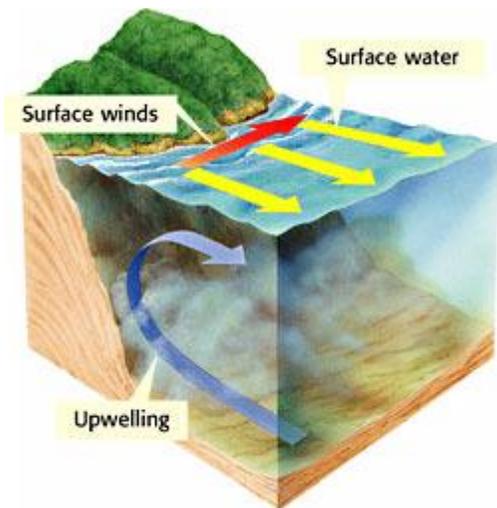
**Standards Check** Why is it important to study El Niño events in relation to changes in weather?

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## Upwelling

At times, local winds blow toward the equator along the northwest coast of South America and the west coast of North America. This wind causes local surface currents to move away from the shore. The warm surface water is then replaced by cold, nutrient-rich water from the deep ocean in a process called **upwelling**. This process is shown in **Figure 4**.



**Figure 4** Upwelling can occur along coastlines when the wind conditions are right.

Upwelling is extremely important to ocean life. The nutrients that are brought to the surface of the ocean support the growth of plankton. These tiny plants and animals support other organisms, such as fish and seabirds. On the California coast, upwelling is usually strongest from March to September. Some weather conditions, including El Niño, can interrupt the process of upwelling. When upwelling is reduced, the richness of the ocean life at the surface is also reduced.

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### Section Summary

- Surface currents cause climates of coastal areas to be more moderate than inland climates at the same latitude and elevation.
- Upwelling is the flow of cold, nutrient-rich water from the deep ocean to the surface.
- During El Niño, warm and cool surface waters change locations. El Niño can cause floods, mudslides, drought, and changes in upwelling.

