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Currents of World Oceans and there Effect on Climate and Weather

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The ocean is a very complex system and it is never at rest. Ocean currents travel around the planet and go through a lot of ups and a lot of downs along their journey. Because ocean waters are so good at holding heat and because the currents are constantly circulating massive amounts of water, oceans are major players in any discussion on global climate. In this lesson, you will learn about the patterns ocean currents take and how they affect climate.

Ocean currents travel at both the surface of the ocean, as well as deep within the ocean basin. Currents are influenced by factors such as wind, the rotation of the earth, differences in the water's salt content, temperature and density, and even the shape of the ocean floor.

The ocean waters are always in motion and as they travel around the globe they carry and distribute heat, which affects the global climate.

INTRODUCTION

Mass flows of water, or currents, are essential to understanding how heat energy moves between the Earth's water bodies, landmasses, and atmosphere. The ocean covers 71 percent of the planet and holds 97 percent of its water, making the ocean a key factor in the storage and transfer of heat energy across the globe. The movement of this heat through local and global ocean currents affects the regulation of local weather conditions and temperature extremes, stabilization of global climate patterns, cycling of gases, and delivery of nutrients and larva to marine ecosystems. Ocean currents are located at the ocean surface and in deep water below 300 meters (984 feet). They can move water horizontally and vertically and occur on both local and global scales. The ocean has an interconnected current, or circulation, system powered by wind, tides, the Earth's rotation (Coriolis effect), the sun (solar energy), and water density differences. The topography and shape of ocean basins and nearby landmasses also influence ocean currents. These forces and physical characteristics affect the size, shape, speed, and direction of ocean currents.

Surface ocean currents can occur on local and global scales and are typically wind-driven, resulting in both horizontal and vertical water movement. Horizontal surface currents that are local and typically short term include rip currents, longshore currents, and tidal currents. In upwelling currents, vertical water movement and mixing brings cold, nutrient-rich water toward the surface while pushing warmer, less dense water downward, where it condenses and sinks. This creates a cycle of upwelling and downwelling. Prevailing winds, ocean surface currents, and the associated mixing influence the physical, chemical, and biological characteristics of the ocean, as well as global climate. Deep ocean currents are density-driven and differ from surface currents in scale, speed, and energy. Water density is affected by the temperature, salinity (saltiness), and depth of the water. The colder and saltier the ocean water, the denser it is. The greater the density differences between different layers in the water column, the greater the mixing and circulation. Density differences in ocean water contribute to a global-scale circulation system, also called the global conveyor belt. The global conveyor belt includes both surface and deep ocean currents that circulate the globe in a 1,000-year cycle. The global conveyor belt's circulation is the result of two simultaneous processes: warm surface currents carrying less dense water away from the Equator toward the poles, and cold deep ocean currents carrying denser water away from the poles toward the Equator. The ocean's global circulation system plays a key role in distributing heat energy, regulating weather and climate, and cycling vital nutrients and gases.

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FACTORS DETERMINING THE DIRECTIONS OF CURRENTS

A.**The Planetary Winds**: Trade Winds which move equatorial waters polewards and westwards and warm the eastern coasts of continents. While westerlies result in a north-easterly flow of water in the northern hemisphere. The planetary winds are probably the dominant influence on the flow of ocean currents. The strongest evidence is in the North Indian Ocean. Here the direction of the currents changes completely with the direction of the monsoon winds which come from the north-east in winter and south-west in summer.

B. **Temperatures**: As warm water is lighter and rises, and cold water is denser and sinks, warm equatorial waters move slowly along the surface polewards, while the heavier cold waters of the Polar Regions creep slowly along the bottom of the sea equatorwards.

C. **Salinity**: Water of high salinity are denser than waters of low salinity. Hence waters of low salinity flow on the surface of waters of high salinity while waters of high salinity flow at the bottom towards waters of low salinity.

D. **The earth's rotation**: The earth's rotation deflects freely moving objects, including ocean currents, to the right. In the northern hemisphere this is a clockwise direction (e.g. the circulation of the Gulf Stream Drift and the Canaries Current). In the southern hemisphere it is an anti-clockwise direction (e.g. the Brazilian Current and the West Wind Drift).

E. **Land**: A land mass always obstructs and diverts a current. For instance, the tip of southern Chile diverts part of the West Wind Drift northwards as the Peruvian Current. Similarly the 'shoulder' of Brazil at Cape Sao Roque, divides the west- flowing equatorial currents into the Cayenne Current which flows north-westwards and the Brazilian Current which flows south-westwards.

TYPES OF OCEAN CURRENTS

The ocean currents may be classified based on their depth as surface currents and deep water currents :

(i) Surface currents constitute about 10 per cent of all the water in the ocean, these waters are the upper 400 m of the ocean;

(ii) (ii) Deep water currents or Thermohaline Currents make up the other 90per cent of the ocean water. These waters move around the ocean basins due to variations in the density and gravity. Deep waters sink into the deep ocean basins at high latitudes, where the temperatures are cold enough to cause the density to increase.

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OCEAN CURRENTS OF THE WORLD

Atlantic Ocean Currents: The trade winds set up a system of equatorial currents which at times extends over as much as 50° of latitude or more. There are two westerly flowing currents conforming generally with the areas of trade winds, separated by a weaker, easterly flowing countercurrent.

The North Equatorial Current originates to the northward of the Cape Verde Islands and flows almost due west .

The South Equatorial Current is more extensive. It starts off the west coast of Africa, south of the Gulf of Guinea, and flows in a generally westerly direction.

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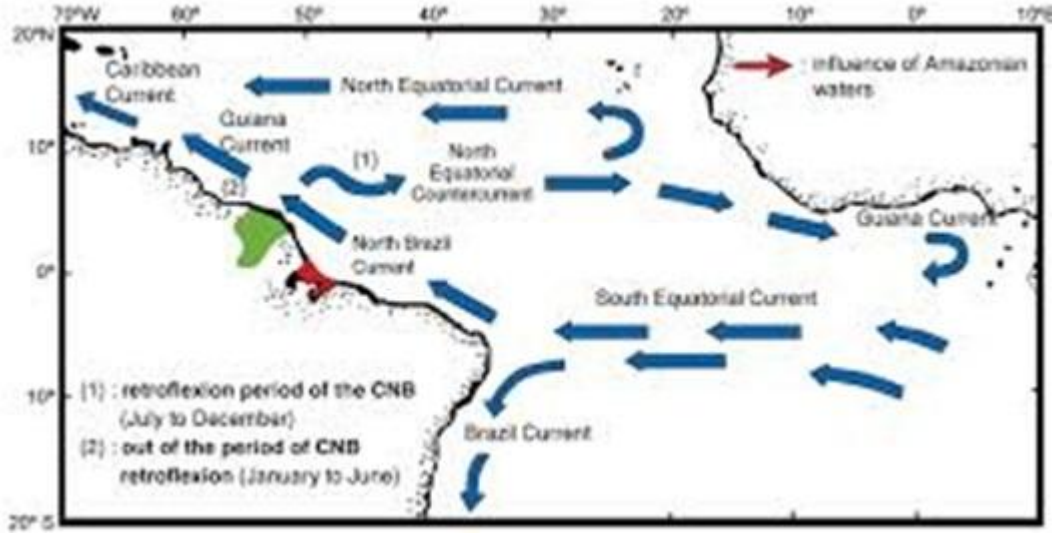

Between the North and South Equatorial Currents, the weaker North Equatorial Countercurrent sets toward the east in the general vicinity of the doldrums. This is fed by water from the two westerly flowing equatorial currents, particularly the South Equatorial Current. The extent and strength of the Equatorial Countercurrent changes with the seasonal variations of the wind.

Within the Straits of Florida, the North equatorial feeds the beginnings of the most remarkable of American ocean currents, the Gulf Stream. Off the southeast coast of Florida this current is augmented by the Antilles Current which flows along the northern coasts of Puerto Rico, Hispaniola, and Cuba.

The Northeast Drift Current continues in a generally northeasterly direction toward the Norwegian Sea. As it does so, it continues to widen and decrease speed. South of Iceland it branches to form the Irminger Current and the Norway Current.

In Baffin Bay the West Greenland Current generally follows the coast, curving westward off Kap York to form the southerly flowing Labrador Current. This cold current flows southward off the coast of Baffin Island, through Davis Strait, along the coast of Labrador and Newfoundland, to the Grand Banks, carrying with it large quantities of ice. Here it encounters the warm water of the Gulf Stream, creating the cold wall.

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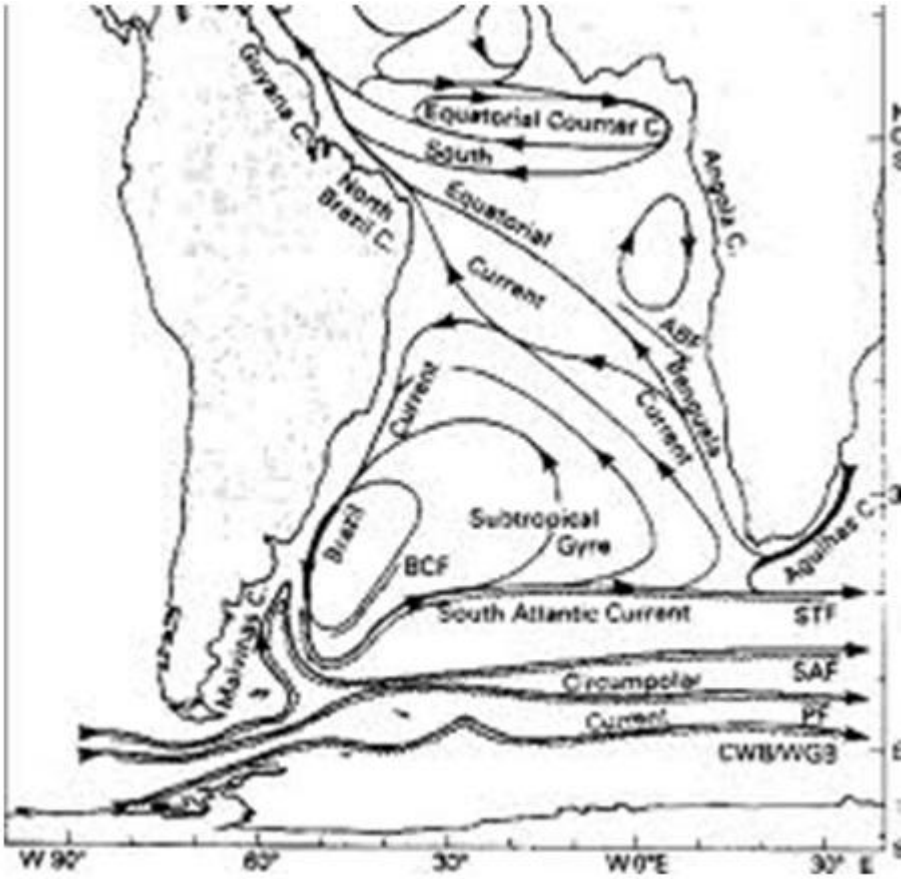
The Southeast Drift Current curves toward the east, southeast, and then south as it is deflected by the coast of Europe. It flows past the Bay of Biscay, toward southeastern Europe and the Canary Islands, where it continues as the Canary Current. In the vicinity of the Cape Verde Islands, this current divides, part of it curving toward the west to help form the North Equatorial Current, and part of it curving toward the east to follow the coast of Africa into the Gulf of Guinea, where it is known as the Guinea Current.

The clockwise circulation of the North Atlantic leaves a large central area between the recirculation region and the Canary Current which has no well-defined currents. This area is known as the Sargasso Sea, from the large quantities of sargasso or gulfweed encountered there.



That branch of the South Equatorial Current which curves toward the south off the east coast of South America, follows the coast as the warm, highly-saline Brazil Current, which in some respects resembles a weak Gulf Stream. Off Uruguay it encounters the colder, less-salty Falkland or Malvinas Current forming a sharp meandering front in which eddies may form. The two currents curve toward the east to form the broad, slowmoving, South Atlantic Current in the general vicinity of the prevailing westerlies and the front dissipates somewhat. This current flows eastward to a point west of the Cape of Good Hope, where it curves northward to follow the west coast of Africa as the strong Benguela Current,augmented somewhat by part of the Agulhas Current flowing around the southern part of Africa from the Indian Ocean.

Pacific Ocean Currents: Pacific Ocean currents follow the general pattern of those in the Atlantic. The North Equatorial Current flows westward in the general area of the northeast trades, and the South Equatorial Current follows a similar path in the region of the southeast trades. Between these two, the weaker North Equatorial Counter current sets toward the east, just north of the equator.

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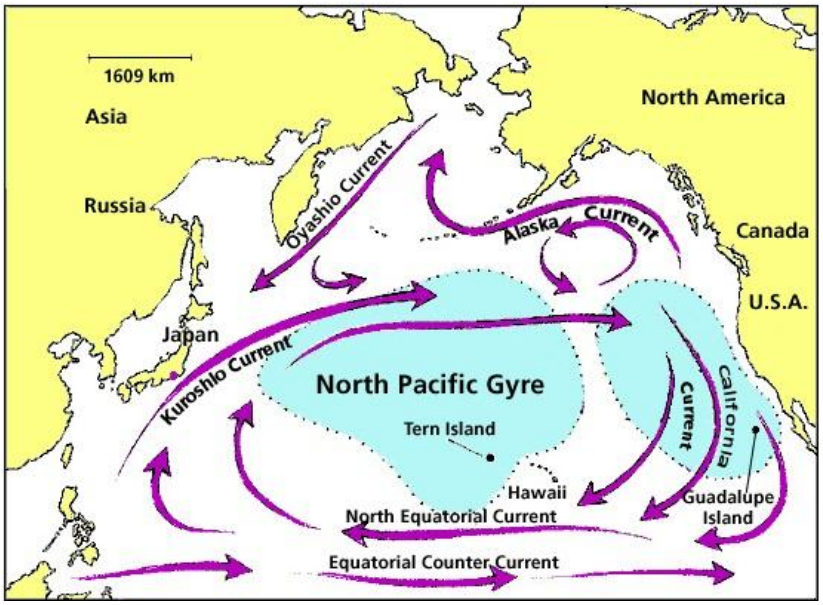
After passing the Mariana Islands, the major part of the North Equatorial Current curves somewhat toward the northwest, past the Philippines and Taiwan. Here it is deflected further toward the north, where it becomes known as the Kuroshio current, and then toward the northeast past the Nansei Shoto and Japan, and on in a more easterly direction. Part of the Kuroshio, called the Tsushima Current.



As this current approaches the North American continent, most of it is deflected toward the right to form a clockwise circulation between the west coast of North America and the Hawaiian Islands called the California Current. in the Atlantic, there is in the Pacific a counterclockwise circulation to the north of the clockwise circulation. Cold water flowing southward through the western part of Bering Strait between Alaska and Siberia, is joined by water circulating counterclockwise in the Bering Sea to form the Oyashio.

The northern branch of the North Pacific Current curves in a counterclockwise direction to form the Alaska Current, which generally follows the coast of Canada and Alaska. When the Alaska Current turns to the southwest and flows along the Kodiak Island and the Alaska Peninsula, its character changes to that of a western boundary current and it is called the Alaska Stream. When this westward flow arrives off the Aleutian Islands, it is less intense and becomes known as the Aleutian Current.

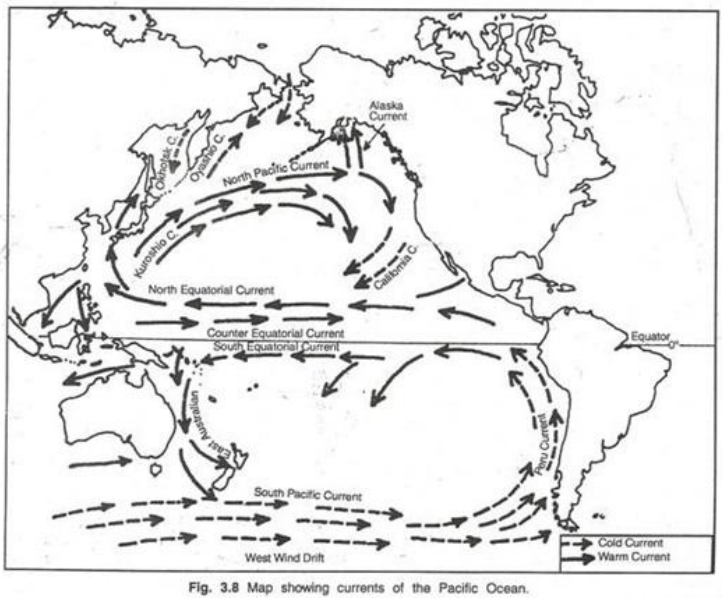


Fig. 3.8 Map showing currents of the Pacific Ocean.

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The South Equatorial Current, extending in width between about 4°N latitude and 10°S, flows westward from South America to the western Pacific. After this current crosses the 180th meridian, the major part curves in a counterclockwise direction, entering the Coral Sea, and then curving more sharply toward the south along the east coast of Australia, where it is known as the East Australian Current.

The continuation of the East Australian Current east of New Zealand is the East Auckland Current. The East Auckland Current varies seasonally: in winter, it separates from the shelf and flows eastward, merging with the West Wind Drift, while in winter it follows the New Zealand shelf southward as the East Cape Current until it reaches Chatham Rise where it turns eastward, thence merging with the West Wind Drift.Near the southern extremity of South America, most of this current flows eastward into the Atlantic, but part of it curves toward the left and flows generally northward along the west coast of South America as the Peru Current or Humboldt Current.

INDIAN OCEAN CURENTS: Being only half an ocean, completely landlocked in the north, the characteristic current circulation of the Indian Ocean is different from that of Atlantic or the Pacific Ocean. The currents in the northern portion of the Indian Ocean differ entirely from the general pattern of circulation. They change their direction from season to season in response to the seasonal rhythm of the monsoons. The effect of winds is comparatively more pronounced in the Indian Ocean.Indian.

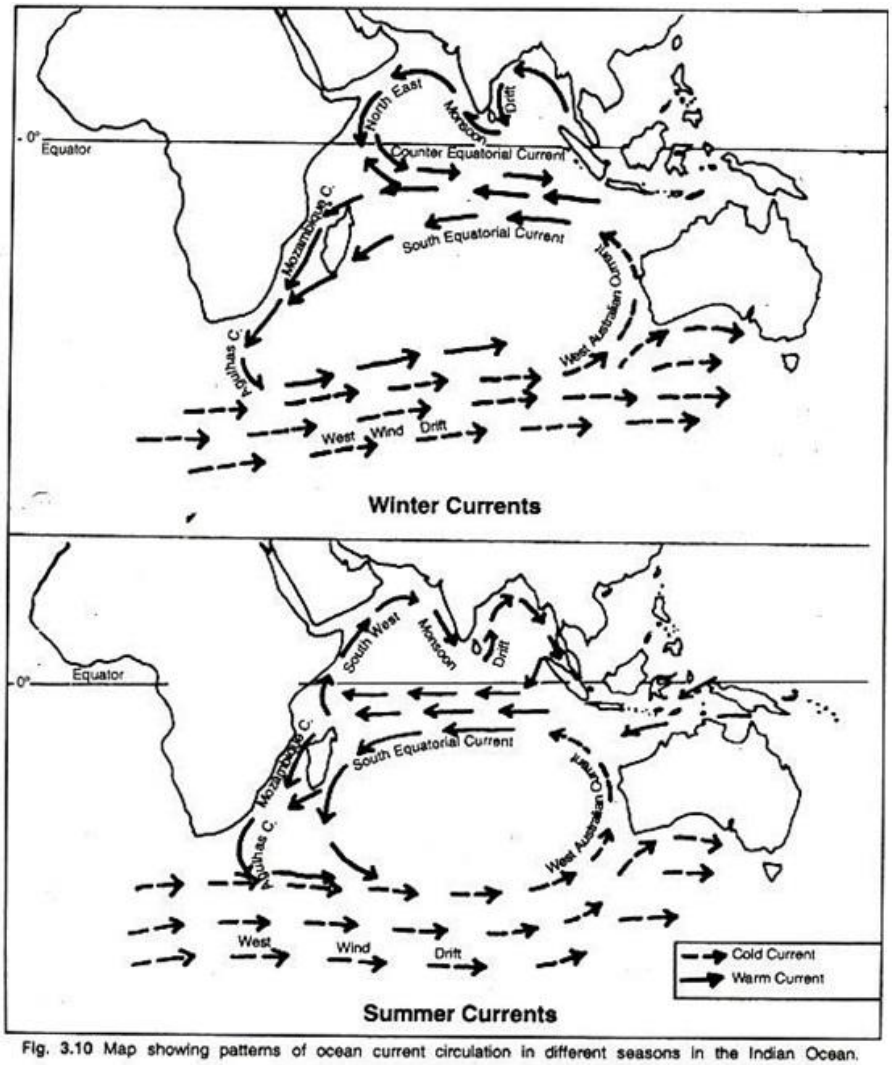

Fig. 3.10 Map showing patterns of ocean current circulation in different seasons in the Indian Ocean.

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During the northern hemisphere winter, the North Equatorial Current and South Equatorial Current flow toward the west, with the weaker, eastward Equatorial Countercurrent flowing between them, as in the Atlantic and Pacific (but somewhat south of the equator). But during the northern hemisphere summer, both the North Equatorial Current and the Equatorial Countercurrent are replaced by the Southwest Monsoon Current, which flows eastward and southeastward across the Arabian Sea and the Bay of Bengal. As the South Equatorial Current approaches the coast of Africa, it curves toward the southwest, part of it flowing through the Mozambique Channel between Madagascar and the mainland, and part flowing along the east coast of Madagascar. At the southern end of this island the two join to form the strong Agulhas Current. South of South Africa, the Agulhas Current retroflects, and most of the flow curves sharply southward and then eastward to join the West Wind Drift; this junction is often marked by a broken and confused sea, made much worse by westerly storms. A small part of the Agulhas Current rounds the southern end of Africa and helps form the Benguela Current.

EFFECTS OF OCEAN CURRENTS ON WEATHER AND CLIMATE

The world's ocean is crucial to heating the planet. While land areas and the atmosphere absorb some sunlight, the majority of the sun's radiation is absorbed by the ocean. Particularly in the tropical waters around the equator, the ocean acts a as massive, heat-retaining solar panel. Earth's atmosphere also plays a part in this process, helping to retain heat that would otherwise quickly radiate into space after sunset.

The ocean doesn't just store solar radiation; it also helps to distribute heat around the globe. When water molecules are heated, they exchange freely with the air in a process called evaporation. Ocean water is constantly evaporating, increasing the temperature and humidity of the surrounding air to form rain and storms that are then carried by trade winds, often vast distances. In fact, almost all rain that falls on land starts off in the ocean. The tropics are particularly rainy because heat absorption, and thus ocean evaporation, is highest in this area.

Outside of Earth's equatorial areas, weather patterns are driven largely by ocean currents. Currents are movements of ocean water in a continuous flow, created largely by surface winds but also partly by temperature and salinity gradients, Earth's rotation, and tides (the gravitational effects of the sun and moon). Major current systems typically flow clockwise in the northern hemisphere and counterclockwise in the southern hemisphere, in circular patterns that often trace the coastlines.

Ocean currents act much like a conveyer belt, transporting warm water and precipitation from the equator toward the poles and cold water from the poles back to the tropics. Thus, currents regulate global climate, helping to counteract the uneven distribution of solar radiation reaching Earth's surface. Without currents, regional temperatures would be more extreme—super hot at the equator and frigid toward the poles—and much less of Earth's land would be habitable.

CONCLUSION

Ocean current is a directed permanent or continuous movement of ocean's water. The movement of the ocean water is caused by forces acting on the water including the breaking waves, salinity differences, Coriolis effects, the wind, temperatures, and cabbeling. The current direction is influenced by the shoreline, other currents, and the depth of the contours. The ocean currents can flow for thousands of kilometers and create a global conveyer belt which is important in determining the climate of different regions of the earth. Ocean currents are either on the surface of the ocean or in the deep waters below 300 meters. The currents can also move either horizontally or vertically depending on the cause. The ocean currents can also be influenced by the shape of the ocean basin, topography, and the land masses bordering the Ocean. Ocean water and currents affect the climate. Because it takes far more energy to change the temperature of water than land or air, water warms up and cools off much more slowly than either. As a result, inland climates are subject to more extreme temperature ranges than coastal climates, which are insulated by nearby water. Over half the heat that reaches the earth from the sun is absorbed by the ocean's surface layer, so surface currents move a lot of heat. Currents that originate near the equator are warm; currents that flow from the poles are cold.

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