Southern AER

Atmospheric Education Resource

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In this issue:

- Climate Creations – exploring mother nature's remote control for weather and Climate.
- Crazy Climate Confusion— test your knowledge of included climate terms with a fun yet challenging crossword puzzle!

Did you know?

- The Pacific Coast experiences fewer thunderstorms than anywhere in the US, less than 10 days per year! The reason? Cold air from the Pacific Ocean keeps coastal temperatures moderately low during the summer.

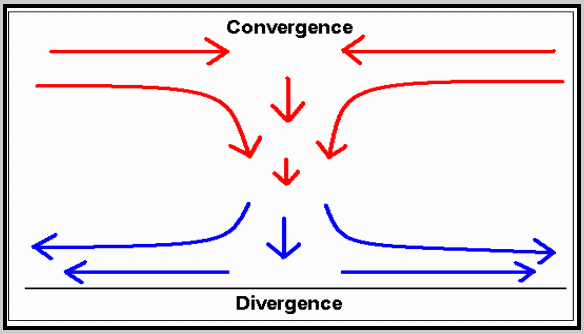
Climate Creations

Have you ever wondered why the climate where you live is much different from the climate in another place? Why is there a lot of winter snow in Michigan, but much less or none in Georgia? Why are places like Arizona and Nevada hot and dry during the summer months, while Florida is very warm and humid? The weather and climate (average weather over time) of a place is determined by *climate controls*. Climate controls are attributes of the land, water, and atmosphere at a given location that determine its normal conditions. The major climate controls discussed in this issue are: latitude, altitude, atmospheric circulation, land/water contrasts, and warm/cold ocean currents.

One of the factors that can affect the temperature of a place is its latitude. *Latitude* is the measure of distance North or South of the equator. A location at high latitude is closer to the North or South Pole, and generally experiences cooler temperatures. A low latitude location is near the equator, where it is normally warm. This explains the difference in temperature between Orlando, Florida and Grand Rapids, Michigan. Orlando, at 28.3 degrees North Latitude, has an average annual temperature of 72.8 degrees. Grand Rapids, much farther North at 42.54 degrees North Latitude, averages at 56.9 degrees yearly. As you can see, latitude has a large impact on the temperature of a location.

Altitude, or distance above sea level, also plays an important role in determining the climate of a place. As the earth's surface stores heat from the sun, it becomes warm, and warms the air just above the surface also. The higher you climb on a mountain, the lower the temperature will be. This is because you are traveling away from the warmth of the earth's surface. If a city is located in a mountainous area that is far above sea level (it has a high elevation), its temperatures will likely be cooler than those of a city that is located in an area closer to sea level. For example, Denver, Colorado and Philadelphia, Pennsylvania are two cities located roughly at the same latitude, however their elevations and average temperatures are different. Denver is 5,260 ft. above sea level, and has an average temperature of 50 degrees. Philadelphia is only 40 feet above sea level, and has a higher average temperature of 54 degrees.

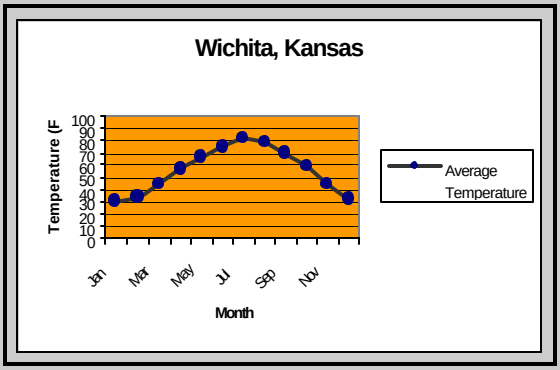
Around the earth there is an organized circulation of air known as *atmospheric circulation*. This general pattern is made up of wind and pressure patterns, such as the jet stream, trade winds, and dominant high and low pressure cells. These patterns are responsible for the transportation of warm and cold air, and often carry along storm systems. Atmospheric circulation can change the temperature of an area by bringing in a warm or cold air mass, or an abundance of clouds, which may cover the sky and block out direct sunlight, cooling the surface. Two types of horizontal air motion (movement parallel to the surface of the earth) are convergence and divergence. *Convergence* can be described as the inflow or coming together of air that causes vertical rising or sinking of air. *Divergence* is the outflow or moving apart of air that also causes a vertical rising or sinking motion.

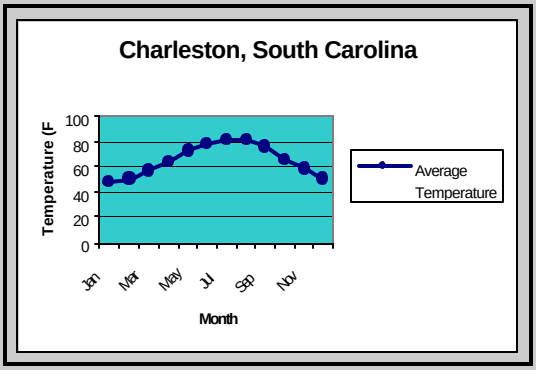


The horizontal and vertical movement of air that makes up the earth's general circulation affects temperature and precipitation patterns, and plays a role in determining the climate of a location.

The climate control that has a large impact on the seasonal change of a place is its proximity (distance) to a large water body, namely an ocean. Consider two locations: Charleston, South Carolina and Wichita, Kansas.

As you can see from the graphs, there is a much greater seasonal temperature range in Wichita than in Charleston.

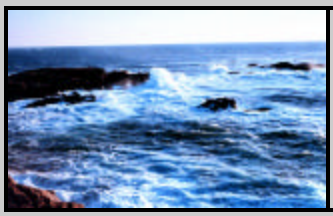




These differences are due largely to the geographic positions of these cities and their distances from the ocean. A large body of water has the ability to moderate climate because of the unique properties of water. *Heat capacity* is the maximum amount of heat a substance can store. Water has a high heat capacity, meaning it can store a large amount of heat, certainly more than the earth's surface. It also takes longer for water to heat up. This means that the maximum temperature of the Atlantic Ocean near Charleston is delayed, or is reached later than the hottest part of summer. Because the ocean is cooler during the summer, Charleston stays several degrees cooler than surrounding inland locations during the summer months. The reverse is also true for the winter months. The ocean water remains warm well into the winter, making Charleston a slightly warmer place than inland cities. The way in which a large body of water creates a milder climate and smaller seasonal temperature change is called the *maritime effect*.

Looking at the map, you may observe that Wichita is many miles away from an ocean. Wichita's climate is affected by the continental effect. The *continental effect* is an impact on climate based only on heating and cooling of the earth's surface. Because there is not an ocean nearby to warm or cool the land in Wichita, and because the earth's surface is heated and cools quickly compared to water, Wichita experiences a greater seasonal difference in temperature than Charleston. Compare the two graphs above. As you can see, the maritime and continental effects have a large influence on climate.

Just as there is a pattern of dominant winds and pressure cells that circulate around the earth (atmospheric circulation), there is also a basic circulation of ocean currents. An *ocean current* is the horizontal movement of surface water. The origin of the current determines its temperature. For example, a current flowing from the Arctic Ocean would have a low temperature while an equatorial current would be warmer. The temperature of a water body also warms or cools the surrounding air. Therefore, ocean currents flowing along continental coastlines affect the climate of coastal and sometimes interior locations. In the United States, the climate on the Atlantic coast is influenced by a different type of current than that of the Pacific coast.

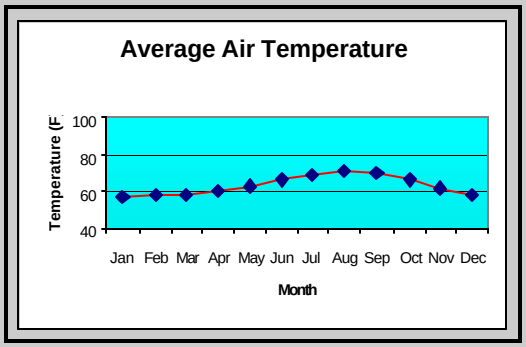


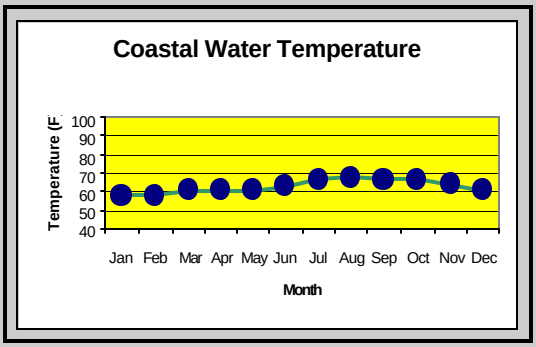
Compare the coastlines pictured here. (Left: Big Sur, California. Right, Folly Beach, South Carolina)

Photos courtesy of NOAA photo gallery.

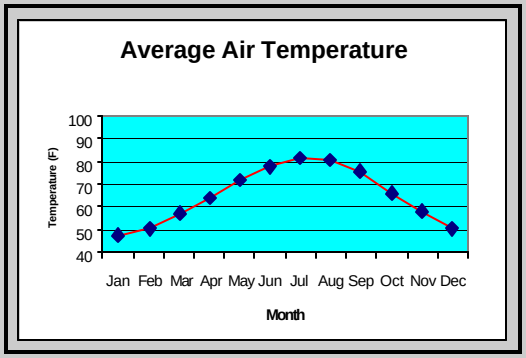
Just off the west coast is the *California Current,* a northerly current (coming from the North) that flows from Alaska and down the west coast. As a result there is cold ocean water year-round at California beaches, leading many surfers to wear wetsuits, even during the summer months. Another more important result of the cold current is its cooling effect on the land. Study the air temperature graphs below. Then, look at the matching water temperature graphs. You can see that during the summer, the ocean water and air temperatures in Los Angeles do not get as warm as those in Charleston. The cold water of the California Current keeps the Pacific coast from extensive heating.

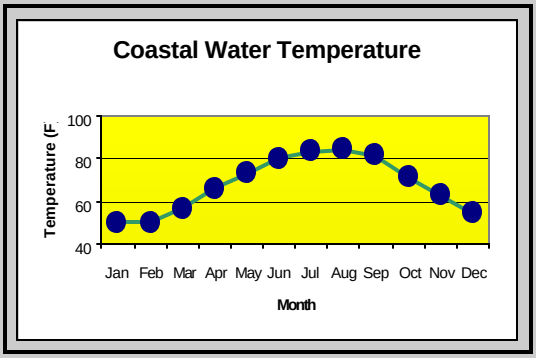
Los Angeles, California





Charleston, South Carolina



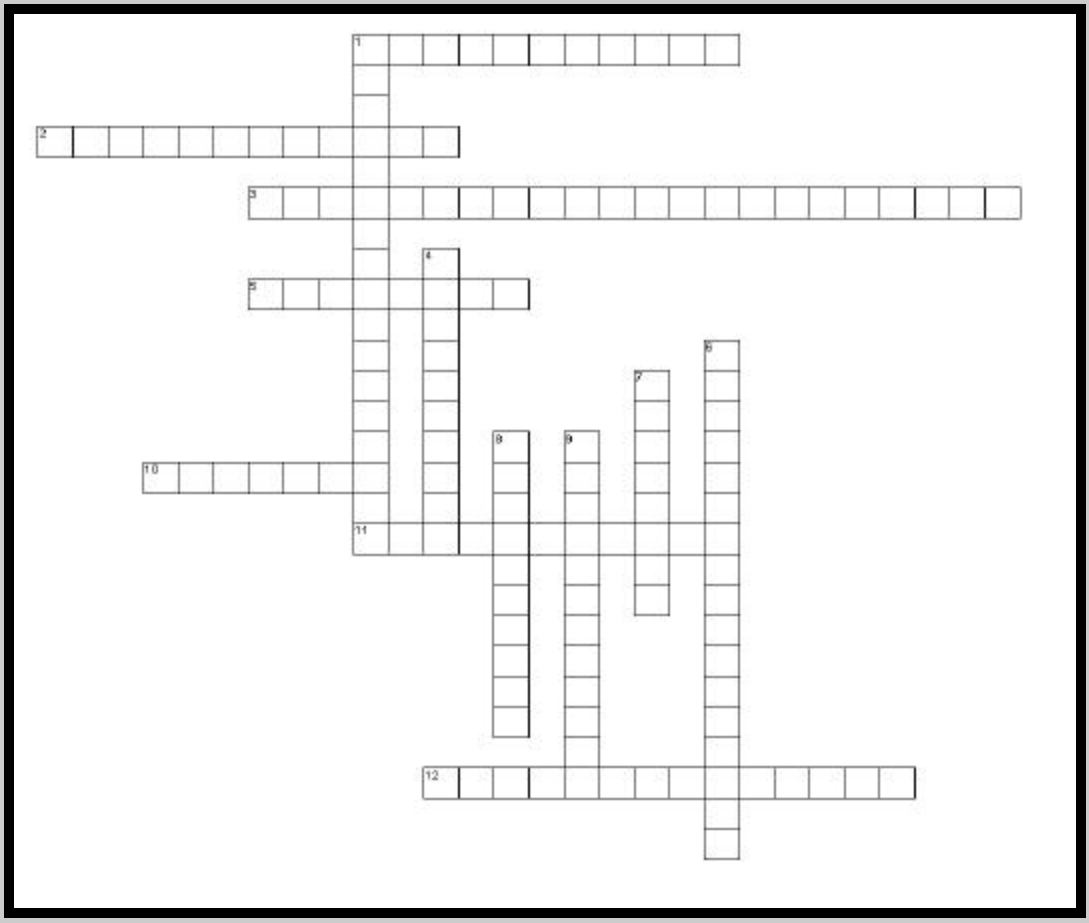


Located approximately 2500 miles east at the same latitude is Charleston, South Carolina. Look again at the US map on page 4. The ocean current that influences climate on the east coast is the Gulf Stream. Because the Gulf Stream originates in the southern Atlantic, it brings warm waters to the eastern coastline of the United States. Look at the air temperature and water temperature charts on page 4. Summer temperatures are higher in Charleston than Los Angeles due to the Gulf Stream. By comparing the charts for the two locations, note the large impact of the California Current and Gulf Stream on the climate of the Pacific and Atlantic coastlines.

You should now have a basic understanding of the factors and processes that create unique climates. Use the vocabulary you have just learned to fill in the crossword puzzle below.

Across:
1.) winds coming together
2.) maximum heat storage
3.) global wind and pressure patterns
5.) measures global distance from the equator
10.) average weather over time
12.) affects only coastal climates

Down:
1.) keeps the west coast cool
4.) keeps the east coast warm
6.) affects only interior climates
7.) describes distance above sea level
8.) winds flowing apart
9.) horizontal movement of water



Short Answer

1.) List the 5 major climate controls discussed in this issue.

2.) Which climate control is most likely responsible for bringing storm systems to your area?

3.) What is one way the temperature of an ocean current might influence human behavior?

True or False

1.) The earth's surface can store more heat than a water body. T or F

2.) The maritime effect impacts locations that are not located near an ocean. T or F

3.) A city located at a high latitude is nearer to the North or South Pole, and has a cooler climate. T or F

4.) Atmospheric circulation describes the pattern of ocean currents around the globe. T or F

5.) A city located near sea level will most likely have a warmer climate than a city in a mountainous are because of the difference in altitude. T or F

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