

FCAT – Climate Work Sheet

Climate vs Weather

In our everyday lives we might use the words climate and weather interchangeably. While both refer to what is happening in our atmosphere, it turns out that these words talk about two very different things. Weather is the state of the atmosphere at a particular time. It refers to what is going on over a very short period of time. Climate is a long term average. Climate looks at the general state of the atmosphere over a long period of time.

The Impact of Land and Water on Climate

It turns out that a region's proximity to a large body of water has a large impact on climate. This is because land and water have different heat capacities. Heat capacity is the amount of energy 1g of a substance needs to heat up 1 degree Celsius. Place two cups in your refrigerator for 5 min. One cup filled with room temperature water, the other cup empty. Which one is cooler after 5min? This is because water has a very high heat capacity. Water must lose or gain a substantial amount of heat before its temperature changes.

If you have ever been to the beach in the day time you might have noticed that the sand can become uncomfortably hot. You might have even run into the water to cool your feet off. Even though both the sand and the water are receiving the same radiation from the sun, the sand is hotter. This is again because water has a higher heat capacity than the land. The land heats up and cools down much faster than the water does. How do you think this affects the air above the land?

The atmosphere receives most of its heat from the land or water below it. In fact, most of the sun's radiation passes right through the atmosphere without warming it. In the day, the land heats up very quickly and causes the atmosphere above it to heat up. As the air warms it expands and becomes less dense than the air around it. As the air rises, cool dense air from off the coast rushes inland to replace it. This is called a sea breeze.

At night the reverse happens. The temperature of the land drops quickly once the sun has gone down. Land's low heat capacity causes it to cool off more quickly than the ocean water. The air over the warm ocean water is in turn warmer and less dense than the air around it. As the air over the water rises, cool dense water off the land rushes out to sea to replace it. This is called a land breeze.

Ocean Currents

Water's high heat capacity affects the climate of regions near the coast. In Florida we have a warm ocean current flowing from the equator. This warm current causes Florida to have a warmer climate than it would have otherwise. Over on the west coast, California has a cold ocean current flowing from the North Pole. This cold ocean current causes California to have a cooler climate than it would have otherwise. In this way locations at the same elevation and latitude can have different climates.

There are two types of ocean currents. Surface ocean currents and deep ocean currents both help to transport heat from the equator to high latitudes. Surface ocean currents are driven by the wind.

The force of the wind on the ocean currents is called wind stress. Deep ocean currents flow due to temperature and salinity differences that cause them to be more or less dense than the surrounding water. (<http://www.youtube.com/watch?v=YCorkyBe66o>)

Earth's Position and Orientation in Space and Climate

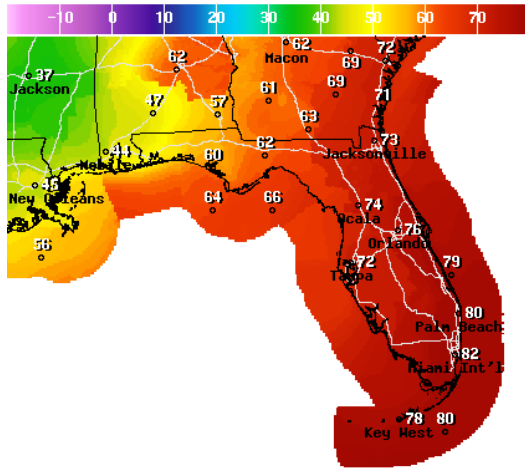
The Earth's rotational axis is tilted 23.5 degrees away from the vertical. This means that during one part of the year the northern hemisphere is pointed toward the sun, and six months later the northern hemisphere is pointed away from the sun. The seasons are caused by the tilt of the Earth's rotational axis. When the northern hemisphere is pointed towards the sun, the northern hemisphere experiences summer and the southern hemisphere experiences winter.

(<http://www.youtube.com/watch?v=DuiQvPLWziQ> ,
http://www.youtube.com/watch?v=taHTA7S_JGk&feature=related)

The climate on Earth is largely dependant on how much solar radiation we receive from the sun. This is called insolation. When the northern hemisphere is pointed toward the sun we receive more direct sunlight from the sun and in turn have a warmer climate. Earth's orbit also affects how much radiation we get from the sun. Earth's orbits the sun in a slightly elliptical manner. This means that our distance from the sun changes throughout the year. During times when earth is closer to the sun the climate is warmer. During times when the earth is farther from the sun the climate is cooler.

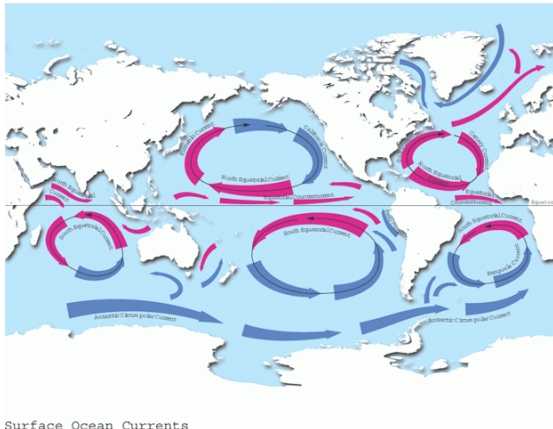
Questions:

1. Define the following words: Climate, Weather, Topography, Density, Salinity, Hemisphere, Elliptical, Insulation, Land Breeze, Sea Breeze, Heat Capacity, Orographic Uplift, Thermohaline Circulation
2. What is the weather like right now in Florida? In general, what is the climate like in Florida? How are weather and climate different?
3. How does the heat capacity of water compare to the heat capacity of land? Will the land or the ocean heat up faster during the day? Which one will cool down faster at night?
4. How does the heat capacity of land and water affect the air above it?
5. Briefly explain what causes a land breeze during the day. Briefly explain what causes a sea breeze during the night.
6. Do warm ocean currents flow towards or away from the equator? Does Florida have a warm or a cool ocean current? How does this affect Jacksonville's climate?
7. Why does the Earth have seasons? Why does the northern hemisphere have winter while the southern hemisphere has summer?
8. What would happen to the seasons if the Earth wasn't tilted? What would happen to the seasons if the Earth's tilt increased?



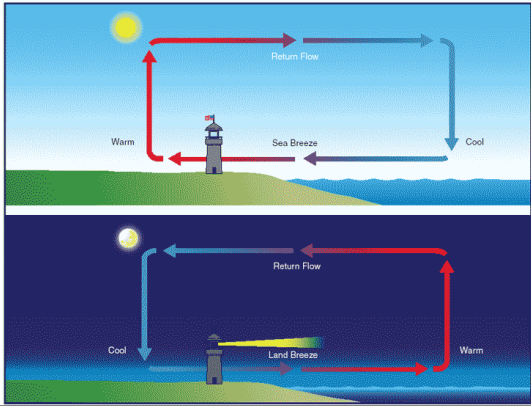
High Temperature(F) Ending Thu Dec 11 2008 7PM EST
 (Fri Dec 12 2008 00Z)
 National Digital Forecast Database
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Proximity to large bodies of water, such as the Atlantic ocean off our coast, causes a difference in climate even at the same latitude.

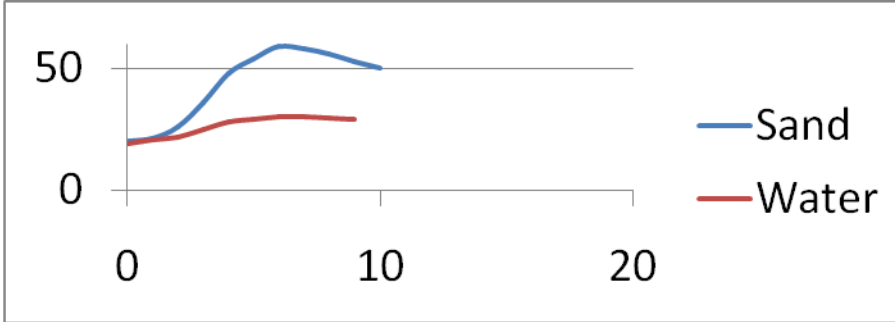


Surface Ocean Currents

Surface ocean currents flowing away from the equator are warm. Surface ocean currents flowing towards the equator are cool. This is because the equator is heated more than the poles.



Land breezes and sea breezes are caused by masses of air being heated differently by the land and the ocean. This is because the ocean has a much higher heat capacity than the land.



Water has a high heat capacity. That means that, over the 10min period of heating and cooling shown to the left, the water's temperature will change less.