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MIAMI

Change in weather as a consequence of global warming

Project Director: Catherine Laroche

Team Leader: Carlos Lizana

Team: Nikolas Bejar, , Raphael Calderon, Ethan Calero, Carlos Cuenca, Kevin Grifo, Michael Mundy,
Carlos Pedroza, Richard Rodriguez

Problem Statement: : What effect will global warming have on the weather in south Florida?

Abstract

Scientists recognize that global warming is changing the earth's climate. There are several natural causes for global warming over geologic time. Evidence shows current global warming is primarily the result of an increase in carbon dioxide in the atmosphere caused by human activities. The results of this climate change include a rise in sea level, ocean acidification, change in the range of vector-borne disease, and stronger storms. Florida will most likely experiences stronger tropical storms and flooding as a result of climate change.

Global Warming

Global warming is the rise in the average temperature of the earth. The world's average temperature has risen during the last 100 years with most of it occurring during the last few decades. Climate change is the primary consequence of global warming which can cause a series of problems including, but not limited to, an increase in sea level, ocean acidification, change in the range of host animals that carry disease, and stronger storms. Florida experiences tropical storms and hurricanes and there is a concern that global warming may be increasing the strength, and perhaps the frequency, of these storms.

There is some confusion regarding climate change and global warming. Scientists have been aware that there are natural variations in the earth temperature through geologic time. By analyzing





indirect evidence from tree rings, ice cores, sediments on the ocean floor, and the remains of ancient pollen, scientists have been able to determine the Earth's climate for the last few hundreds of thousands of years. Scientists can easily recognize that the earth has gone through a series of warming and cooling cycles. Natural phenomena can cause some of these differences in the earth's temperature and most involve increasing or reducing the amount of solar energy from reaching the surface of the earth.

Volcanic eruptions can send ash and dust particles into the atmosphere that reflect sunlight, and therefore cool the planet. In 1816, the Indonesian volcano called Tambora erupted resulting in a worldwide cool summer that became known as the "year without



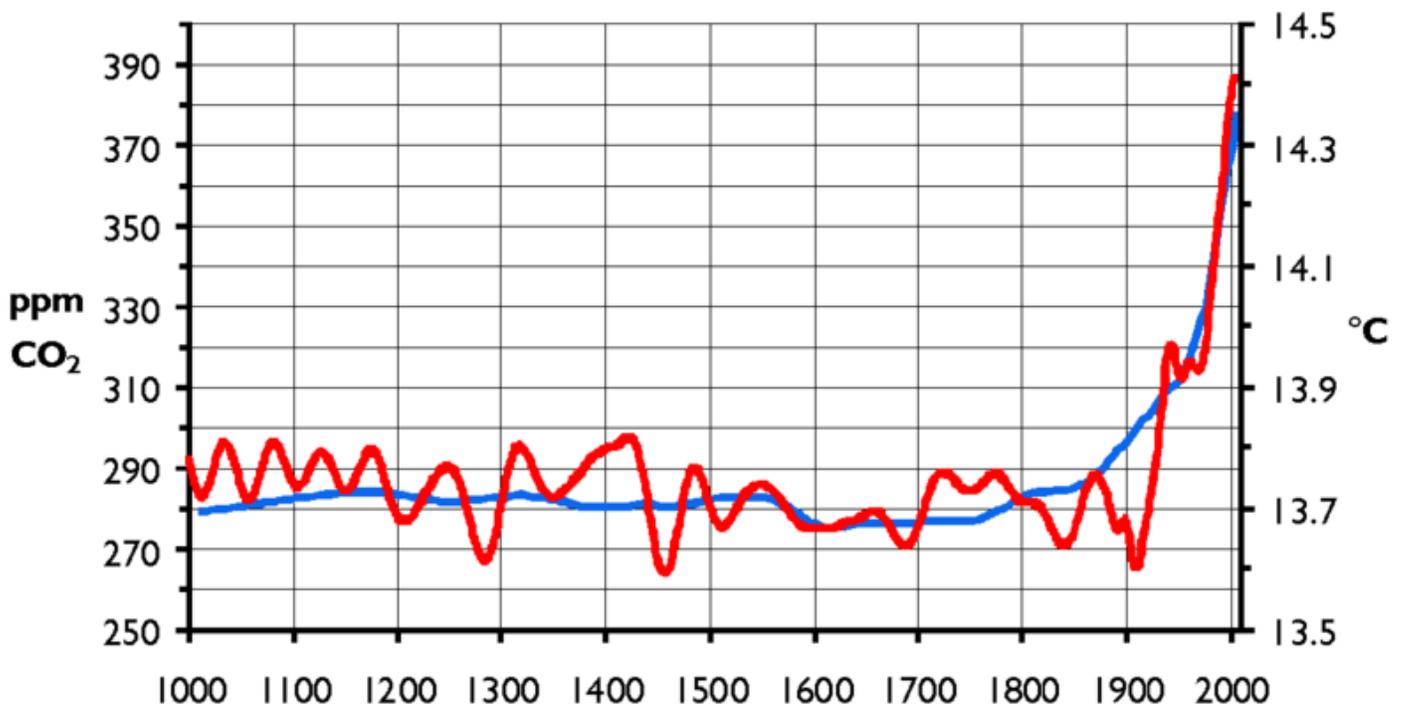
a summer." This type of volcanic activity has occurred for millions of years and is considered a valid explanation for some geologic time periods as being cooler. On the left is a picture of a volcanic eruption showing the huge amount of ash and dust moving upward into the atmosphere.

The Milankovich cycles take into account the effect of the earth's wobble of its axis (precession), the tilt of the earth's axis (obliquity), and the change in how elliptical the earth's orbit is around the sun (eccentricity) on changes in the earth's temperature. These can cause alternating cycles of increasing and decreasing solar energy in reaching Earth. Only recently have the Milankovich cycles been recognized as having a significant impact on natural changes in the earth's temperature. However, it is important to realize that these cycles last for thousands of years so they are not responsible for the recent changes in climate, only geologically old ones.

Albedo is the reflection of solar radiation off a surface. During ice ages, the white snow and ice increases the reflection resulting in cooler climates. As the earth warms from other causes, the amount of ice melts, reducing the albedo effect. This causes even more warming of the planet.

Some other natural causes for changes in the earth's temperature include variations in solar energy due to sunspots, shifting of the locations and size of land masses due to continental drift, changes in ocean currents, an increase of atmospheric dust particles caused by meteor or asteroid impacts, and release of greenhouse gases into the air by massive forest fires.

Climate change is the result of global warming. As the earth warms, it results in a shift of climate zones. Areas that may in the past have had moderate rainfall may now be experiencing long drought. Climate changes have already been noticed. In fact, com-



panies that make seed packets have changed their instructions as when to plant seeds to adjust to a longer growing season. The instructions now have people plant seeds earlier than they used to. The climate zones in the United States have shifted northward by about 100 miles.

Human Impact on Global Warming

Evidence is overwhelming that human activities have accelerated global warming. Natural global warming is essential for life. The earth produces a natural amount of greenhouse gases. These are gases that trap heat that enters earth from the sun and then keeps the heat from escaping back into space. This heat warms the earth the same sort of way that the roof on a plant greenhouse keeps the air inside the greenhouse warm and humid. The plants in the greenhouse grow because they like the heat and humidity. If greenhouse gases did not exist, then earth would be cold and life would not be able to exist.

One of the most important greenhouse gases is carbon dioxide (CO₂). Natural processes produce enough carbon dioxide to keep plants and animals alive, but since the beginning of the industrial revolution in the mid 1800's the amount of carbon dioxide has steadily been increasing. There is a direct relationship between the increase in factories and an increase in carbon dioxide. Carbon dioxide is a pollutant that comes not only from factories but also

from automobiles. As the population of the earth increases, so does the number of factories and as well as the number of cars, and therefore, so does the amount of carbon dioxide in the air. As there is more carbon dioxide, then there is an increase in the temperature of the earth. Below is a chart that shows the relationship that as carbon dioxide increases, so does the temperature of the earth.

Weather Change and Global Warming

A noticeable side effect of global warming is that weather is being altered. The earth is not only becoming hotter than usual, but a result of the warming trend is the speeding up of the movement of water in the water cycle. Moisture is cycling faster between the ocean, atmosphere and land. The results of this faster transfer of water include more brushfires, drought, flooding, and intense storms. It may seem odd, but increasing the temperature of the earth can result in some parts of the earth being cooler and wetter. As expected, other parts are becoming warmer and drier. In other words, climate is changing.

As climate is changing, there are parts of earth which are experiencing longer, hotter, drier conditions. These conditions are perfect for brushfires. Areas that are being affected by an increased chance of brushfires as a result of climate change are the southwestern United States and parts of Australia.

Parts of Africa are being severely affected by

drought. Some of these areas have already been experiencing long periods of drought and famine. It is sad, but the amount of area that has been experiencing severe drought has doubled since the 1970's. The area of the Sahara desert is growing. It is now estimated that between 75 to 250 million people in Africa are having trouble finding enough water to survive. This is adding to the political problems that already exist in Africa.

Some parts of the earth are experiencing more rain than before and some of this is related to climate change. As climate zones shift and weather patterns change, rainfall will increase in tropical zones near the equator. The extreme northwestern portion of the United States is also expected to have more heavy rain along with portions of Asia that normally experience monsoons. As expected, these areas of heavy rain are expected to experience heavy flooding.

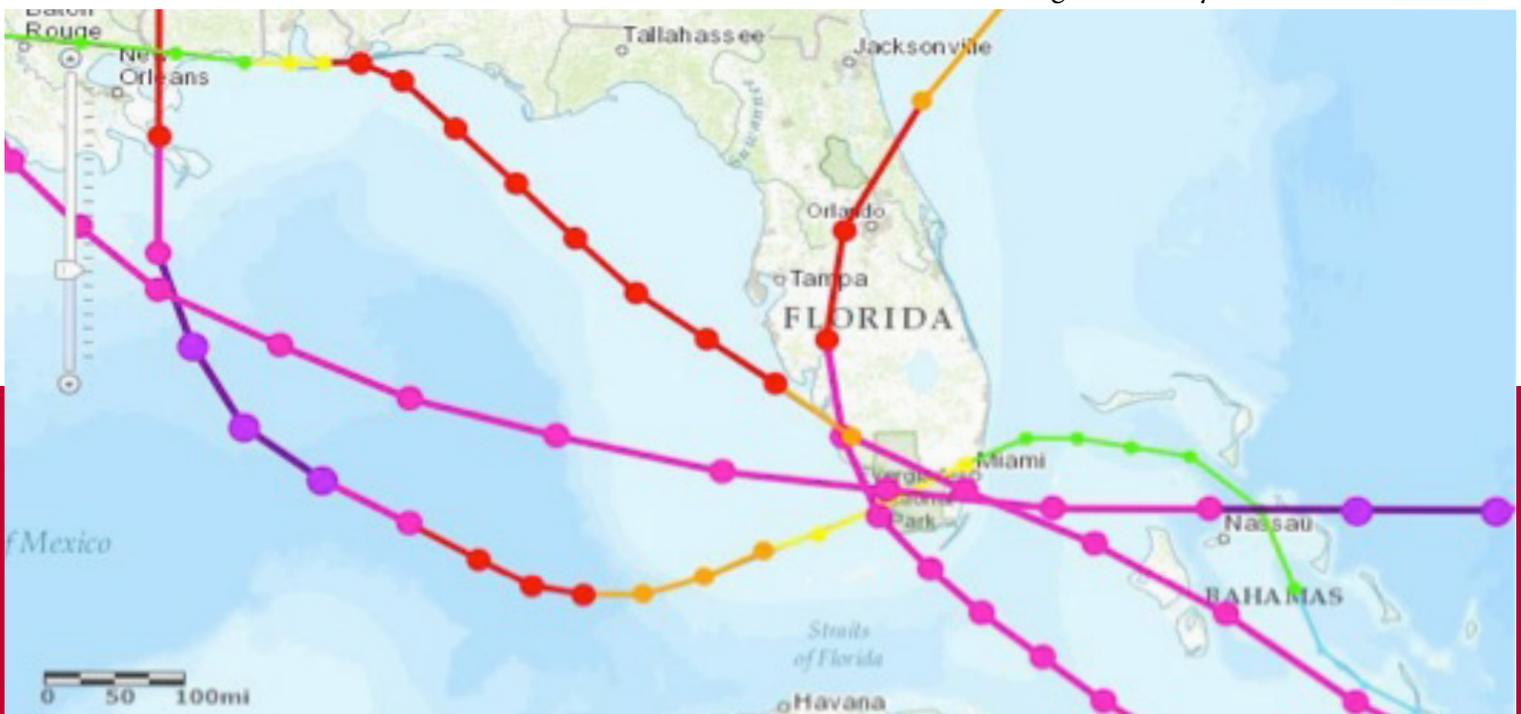
South Florida and Climate Change

Climate change poses to problems for south Florida: increase in more intense hurricanes, and coastal flooding. Looking at Florida's weather history, it is obvious that Florida is susceptible to natural disasters from hurricanes. In 1992, south Florida was hit by Hurricane Andrew, which devastated the Miami area. 2004 and 2005 were extremely busy hurricane seasons, and Hurricane Wilma did a lot of damage. All of Florida is in the path of hurricanes. Below is a MyCOE map showing the paths of some major hurricanes as they cross over south Florida.



Although not all agree, many scientists are suggesting that hurricane strength will increase as the temperature of the earth increases. There is no proof that hurricanes Katrina, and the recent storm Sandy that hit the northeast coast this last winter, were caused by global warming, but most climate specialists believe that their intensity was at least maintained by waters that remained warm. As the ocean water remained warm, it continued to feed energy into the storms allowing them to gain or at least to keep their strength. If the water had been cooler, there would not have been enough energy to keep the hurricanes alive and they would have weakened and died out.

Hurricanes are not the only problem with climate change for south Florida. South Florida is relatively flat, making it easy for flooding to occur, by even minor storm wave action and storm surges. As the earth warms, the ice in Greenland and Antarctica will melt. This will cause the sea level to rise and also flood south Florida. The warming water may increase the intensi-



ty of storms, bringing more rain and raising water levels some more. Approaching storms will already have an elevated sea level upon which to raise their waves and storm surge. South Florida was not hit by Sandy, but it did pass along next to Florida. Because sea level was already high due to high tide, the storm waves caused flooding in Miami Beach that lasted for several days. This is only a taste of what is to happen in the future.



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