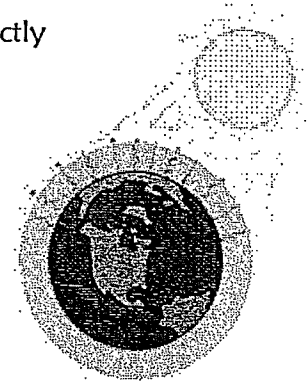


Background: Climate Data

Earth's Climate Changes

Earth's climate is constantly changing and has been for millions of years. There have been periods in Earth's history where it was colder and covered in ice (called glacier periods) and other periods that were much warmer (interglacial periods). Levels of the gases that make up Earth's atmosphere, such as oxygen, carbon dioxide, and nitrogen, have changed, as well. These changes are a part of Earth's natural processes. It is no surprise that Earth is still experiencing climate changes today, just as it has throughout history. However, scientists believe that human activity has been negatively affecting this natural process, causing carbon dioxide levels and the temperature of Earth to unnaturally trend upwards.

Carbon dioxide levels in the atmosphere and the temperature of Earth are directly related to each other. This is because carbon dioxide is a *greenhouse gas*. Greenhouse gases are gases that exist normally in the atmosphere, and act like an insulator for Earth. These gases help to trap the Sun's heat energy. Without these greenhouse gases, Earth would be too cold to support life. So, greenhouse gases at their natural levels are very important! However, since the Industrial Revolution, people have been burning fossil fuels at enormous rates to power factories, electricity production, and transportation. This process adds lots of extra carbon dioxide to the atmosphere – more than would occur naturally. That means an increase in the *greenhouse effect*, and therefore more heat may be trapped than usual.



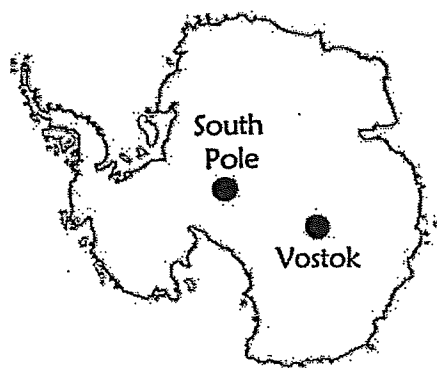
Scientists can compare changes that are occurring in today's climate to those throughout Earth's history. How is this possible? Before people invented thermometers – before humans even walked the Earth – the Earth itself recorded clues about temperature and carbon dioxide levels. Ice that accumulated eons ago holds these clues. To find them, scientists analyze ice core data. Using this data can help scientists to figure out if the current increase in carbon dioxide and temperature fits a natural pattern or not.

Ice Core Data

Glaciers form when years and years of snow accumulate on top of each other. Each year's layer of snow is a little bit different. Over time, the buried snow compresses, forming ice. Bubbles of trapped air and particles (such as pollen and dust) that were captured by the falling snow become a part of the ice. These layers create a record of climate conditions over Earth's history, including snowfall accumulations, temperatures, and levels of different gases in the atmosphere.



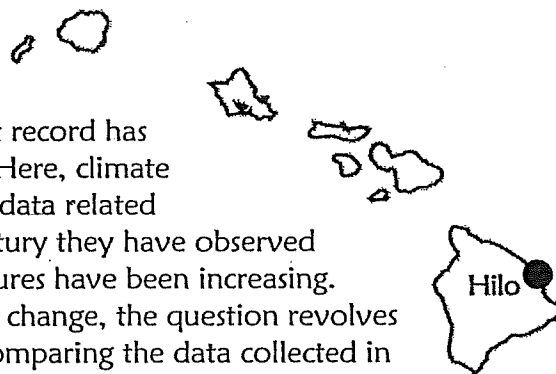
Scientists can analyze this record by obtaining *ice cores* - cylinders of ice drilled from ice sheets and glaciers. Layers in ice cores correspond to years and seasons, with the youngest at the top and the oldest at the bottom. Ice cores are essentially time capsules that allow us to look back at the Earth's past climates. By analyzing the ice cores, scientists are able to determine what gases were in the atmosphere and in what amounts, what the climate was like when the snow fell, and how the ice and glaciers have changed due to different climate conditions. This information allows scientists to make hypotheses about how and why the climate changed in the past.



Today you will analyze information about past climates using data from an ice core from Vostok, Antarctica collected in the 1990's. The ice core from Vostok reached a depth of 3,623 meters and was 400,000 years old at the bottom! Scientists are now finding ice samples in other areas that are even deeper and older – 2 miles deep and up to 8 million years old – allowing us to look even farther back into the past of Earth's climate history.

Modern Data

Along with data from the Vostok ice core, you will also be provided with data from today's times. For a few decades now, carbon dioxide and temperature data has been collected at sites around the world, but the longest record has been kept at the Mauna Loa Observatory in Hilo, Hawaii. Here, climate scientists have been continuously monitoring and collecting data related to atmospheric change since the 1950's. For over half a century they have observed that the levels of atmospheric carbon dioxide and temperatures have been increasing. However, because we know that historically these levels do change, the question revolves around the impact of human activity on this increase. By comparing the data collected in recent years to the data scientists have obtained from ice cores, we can learn a lot about what affects climate, how it changes, and if the changes we are seeing today are a part of natural processes or not.



Getting Familiar With the Data

Both sets of data that you will analyze today, including historical data from the Vostok ice cores and modern data from the Mauna Loa Observatory, will provide you with two important climate clues – carbon dioxide levels and temperature.

The carbon dioxide value provided is “ppm” – parts per million. This tells us how many carbon dioxide particles are in a million particles of air. So, a concentration of 400 ppm means that for every million air particles, 400 of them are carbon dioxide molecules. Remember that carbon dioxide is a greenhouse gas and helps to trap heat in Earth's atmosphere, so understanding changes in carbon dioxide levels is very important to understanding climate changes.

Earth's temperature data is provided as a “temperature anomaly” value. This value means how far off the temperature is from the average, or baseline, temperature. The baseline temperature is typically calculated by averaging 30 or more years of temperature data. A positive number means that a year was warmer than average, and a negative number means that a year was cooler than average. Understanding historical patterns in global temperatures is an important piece in understanding Earth's current temperature trends.

