Ice core studies confirm accuracy of climate models

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An analysis has been completed of the global carbon cycle and climate for a 70,000 year period in the most recent Ice Age, showing a remarkable correlation between carbon dioxide levels and surprisingly abrupt changes in climate.

The findings, to be published this week in the online edition of the journal *Science,* shed further light on the fluctuations in greenhouse gases and climate in Earth's past, and appear to confirm the validity of the types of computer models that are used to project a warmer climate in the future, researchers said.

"We've identified a consistent and coherent pattern of carbon dioxide fluctuations from the past and are able to observe the correlation of this to temperature in the northern and southern hemispheres," said Ed Brook, an associate professor of geosciences at Oregon State University. "This is a global, interconnected system of ocean and atmosphere, and data like these help us better understand how it works."

The analysis was made by studying the levels of carbon dioxide and other trace gases trapped as bubbles in ancient ice cores from Antarctica.

In the last Ice Age, as during most of Earth's history, levels of carbon dioxide and climate change are intimately linked. Carbon dioxide tends to rise when climate warms, and the higher levels of carbon dioxide magnify the warming, Brook said. These natural cycles provide a "fingerprint" of how the carbon cycle responds to climate change.

In contrast to the relatively low levels of carbon dioxide in the Ice Age, the burning of fossil fuels since the Industrial Revolution has led to levels of greenhouse gases that by comparison are off the charts. The level of atmospheric carbon dioxide today is about 385 parts per million, or more than double that of some of the lower levels during the Ice Age. These changes have taken place at a speed and magnitude that has not occurred in hundreds of thousands of years, if not longer. Past studies of ice cores have suggested that Earth's temperature can sometimes change amazingly fast, warming as much as 15 degrees in some regions within a couple of decades.

The question everyone wants to know is what all this will mean in terms of future climate change.

"Before humans were affecting the Earth, what we are finding is regular warm and cold cycles, which both began and ended fairly abruptly," Brook said. "This study supports the theory that a key driver in all this is ocean currents and circulation patterns, which create different patterns of warm and cold climates depending on the strength of various parts of the global ocean circulation system."

This issue is of more than academic interest – one of the primary circulation patterns is referred to scientifically as "meridional overturning circulation." When that current is moving large amounts of warm water from the equator to the north, it helps to warm the high latitude parts of the Northern Hemisphere, and particularly the North Atlantic region. When the system stops or dramatically slows, as it has repeatedly in the past, Greenland and Europe get much colder while the Antarctic regions become warmer, Brook said.

"In every historic sequence we observed, the abrupt warming of Greenland occurred about when carbon dioxide was at maximum levels," Brook said. "And that was during an Ice Age, and at levels of

atmospheric carbon dioxide that are far lower than those we have today."

Source: Oregon State University