

What Are the Scientists Saying About Global Climate Change?

Written by Judy D'Amore, Marine Science Centers,
Port Townsend and Poulsbo, Washington.

Key Concepts

1. The earth is currently warmer than it has been throughout most of the past million years.
2. Major climatic changes in the history of the earth, such as ice ages, have been accompanied by temperature changes of only a few degrees.
3. Climate changes in the past are correlated with changes in atmospheric concentration of carbon dioxide and methane.
4. Predictions based on scientific models include temperature changes equal to or greater than those which occurred between periods of continental glaciation (inter-glacial periods). They also include significant changes in rainfall distribution.



Background

Background information for “What Are the Scientists Saying About Global Climate Change?” is found in the preceding activity entitled “Greenhouse Earth”.

Materials

For each student:

- Student activity guide: “What Are the Scientists Saying About Global Climate Change?”

Teaching Hints

“What Are the Scientists Saying About Global Climate Change?” provides students with an introduction to global change data and to current atmospheric and meteorological thoughts on global climate.

The content of this lesson has been prepared as a student text with questions. You may prefer to deliver the material via lecture/discussion, by preparing graphs and maps as overheads or handouts.

Whichever way you choose to present this material, allow plenty of time to discuss this information and its implications for the future.

Answer Key

1. The decade from 1980 to 1990 was the warmest.
2. Since the question calls for an opinion, answers will vary. Scientists know a trend this short in geologic time might be caused by factors other than the greenhouse effect. Most atmospheric scientists do believe that global warming will soon be detectable, however.
3. There are thought to have been 9 or 10 glaciations.
4. During most of the past 900,000 years it was cooler. During inter-glacial periods (the periods between ice ages) the earth reached temperatures as high or even slightly higher than it is now.
5. The earth became as warm as it is now 6 times, not counting the present.
6. The earth's temperature variation between glacial periods and inter-glacial periods was 4-5°C. (Note: There is a discrepancy between units on graph #2 and graph #4 which students may notice. This figure is based on the information on graph #2.)
7. a. Both carbon dioxide and methane levels rise and fall with the earth's temperature during this period.

b. Possible explanations will vary. Whether the atmospheric concentration of carbon dioxide was brought on by the temperature changes or whether the gas caused the temperature changes is not known.
8. No, carbon dioxide levels have never been as high as they are now.
- 9 a., b. Answers will vary. Students might mention that the level of carbon dioxide in the atmosphere has not been as high as it is now in 900,000 years, and there is much we don't know about how this will affect our planet's future climate. Until the last 200 years we have not had the technology to deforest vast areas of our planet, or to mine and burn fossil fuels at our present rate. In the future, the fossil fuel resources and forest resources will not be available for such an "experiment". Note that some students may find this question difficult to answer. Be sure to use the discussion time to emphasize the idea that before the

present era humans were not capable of producing such an impact on the earth's atmosphere and that, while we do not know for sure what the results of our impact will be, they could be very serious indeed.

Reference: *Climate Change: The IPCC Scientific Assessment*, edited by J.T. Houghton et al. The Intergovernmental Panel on Climate Change, Cambridge University Press, 1990.

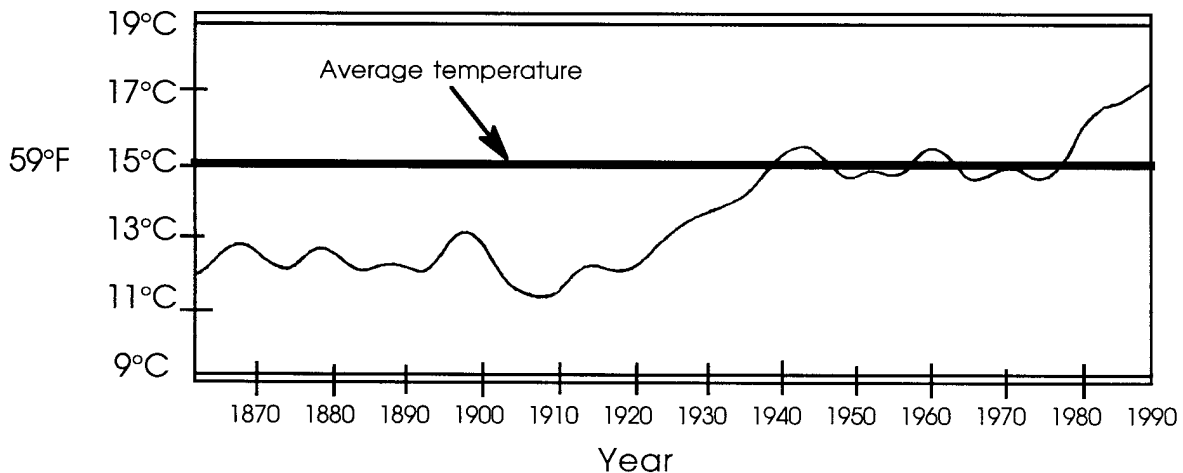
What Are the Scientists Saying About Global Climate Change?



The Earth's Climate of the Past

We know the atmosphere is changing, but is the earth getting warmer? To answer this question, scientists need long-term records of temperatures. The records need to be taken from many parts of the earth's surface. Unfortunately, such records weren't kept before the middle of the 19th century. However, we do have good records from about 1860 to the present.

The graph below shows what we know about the earth's temperature for the past 130 years.



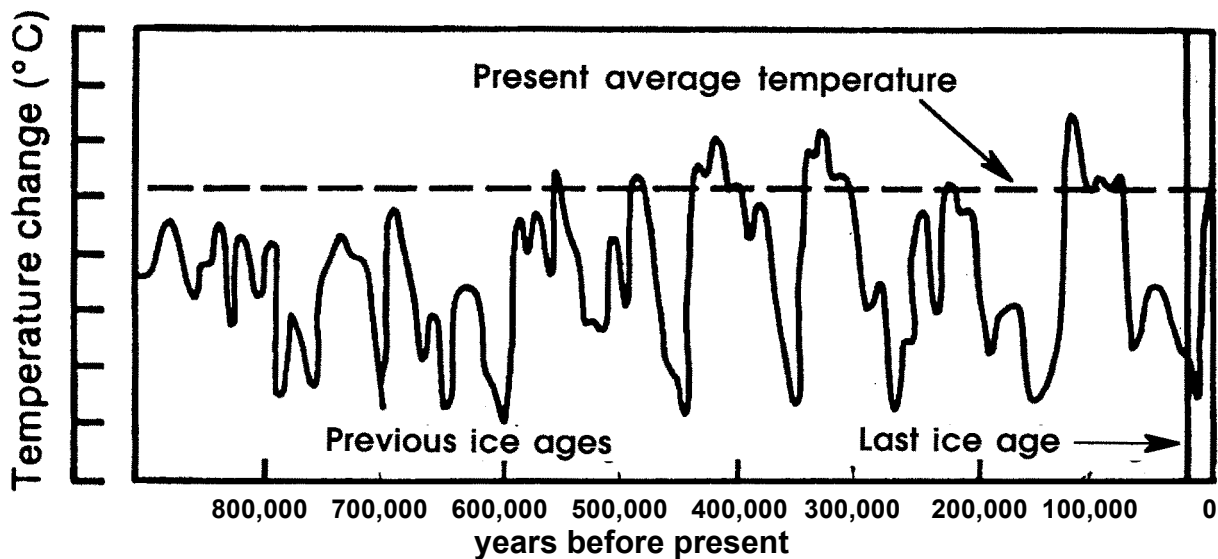
(Graph based on information from IPCC Scientific Assessment, p. xxix.)

1. During which decade were the warmest temperatures recorded?
2. This graph seems to show that the earth is getting warmer. Why do you think scientists are cautious about making predictions about the future from this information alone?

Other research is looking into clues about the earth's climate during much earlier periods. You might wonder where scientists look for this information.

Some clues are found in particles trapped deep inside the ice sheets on Antarctica. These ice sheets formed thousands of years ago. Scientists can also look at the structure of the shells from marine animals buried in ocean sediments. The shells help them to learn how much of the earth's water was in the ocean and how much was bound up in glaciers. Finally, they can learn about past climates from pollen grains trapped in ancient mud deposits. By combining information, scientists have pieced together a picture of the earth's climate deep into the earth's past.

The following graph shows how we think the earth's temperature has changed over the past 900,000 years.



3. Look for the sharp dips in the earth's temperature over this period. They show that the earth probably passed through ice ages many times. How many ice ages can you count, including the most recent one? (Hint: Do you find it difficult to answer this question? Know that scientists themselves do not agree on how many glacial periods there were!)

4. In general, would you say the earth's temperature over the last 900,000 years was higher or lower than its present temperature?

5. How many time during this period was the earth's temperature as warm or warmer than at present?

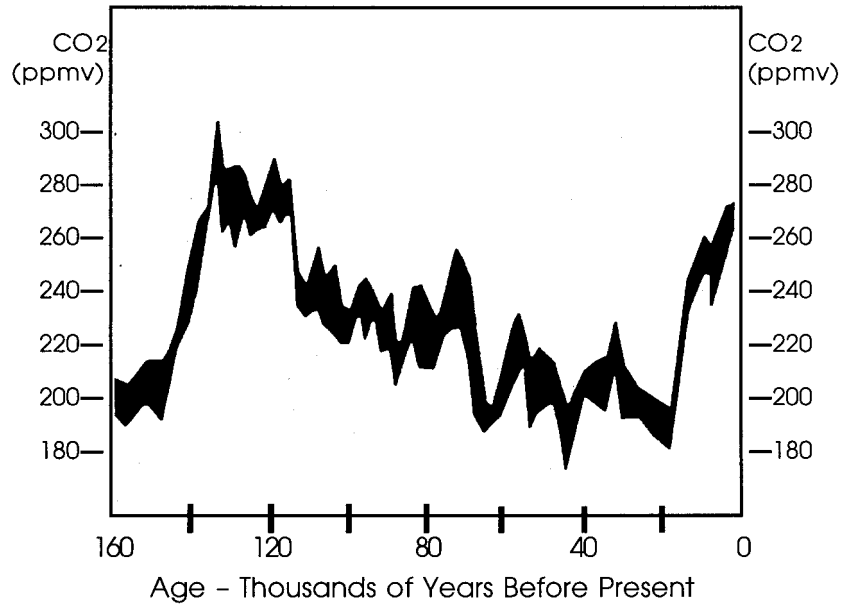
6. About how much did the temperature of the earth change between the glacial periods (ice ages) and the inter-glacial periods?

The Earth's Atmosphere of the Past

In studying how the earth's climate has changed, scientists would also like to know whether the atmosphere has changed during this period too. To find out, they have captured and analyzed air bubbles trapped in the Antarctica ice sheet. The graph below shows what we know about the concentration of carbon dioxide in the atmosphere over the past 160,000 years. Compare it to graph #4, the earth's average temperature over the same time period.

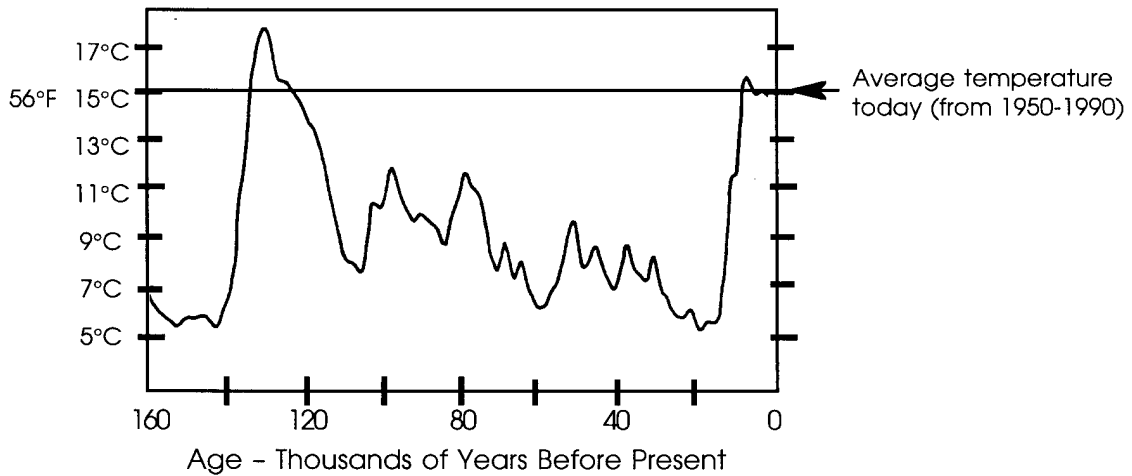
graph 3

**Carbon Dioxide in the Atmosphere
160,000 Years Ago to Present**



graph 4

**Temperature of Earth's Surface
160,000 Years Ago to Present**



(Graphs based on information from IPCC Scientific Assessment, p. 202.)

7. a. What do you notice about these two graphs?
- b. What are some possible explanations?
8. Today's atmosphere contains about 350 ppm (parts per million) of carbon dioxide. During the period of this graph, was it ever before as high as its current level?
9. Dr. Roger Revelle is an oceanographer at Scripps Institution. He has said that by changing the atmosphere, people are making a giant "experiment of a kind that could not have happened in the past nor be reproduced in the future".
- a. What does he mean by this statement?
- b. Do you agree with him?