

September 2001

# ARM Facilities Newsletter

ANL/ER/NL-01-09



## Our Changing Climate

Is our climate really changing? How do we measure climate change? How can we predict what Earth's climate will be like for generations to come? One focus of the Atmospheric Radiation Measurement (ARM) Program is to improve scientific climate models enough to achieve reliable regional prediction of future climate.

According to the Environmental Protection Agency (EPA), the global mean surface temperature has increased by 0.5-1.0°F since the late 19<sup>th</sup> century. The 20<sup>th</sup> century's 10 warmest years all occurred in the last 15 years of the century, with 1998 being the warmest year of record.

The global mean surface temperature is measured by a network of temperature-sensing instruments distributed around the world, including ships, ocean buoys, and weather stations on land. The data from this network are retrieved and analyzed by various organizations, including the National Aeronautics and

Space Administration, the National Oceanic and Atmospheric Administration, and the World Meteorological Organization. Worldwide temperature records date back to 1860. To reconstruct Earth's temperature history before 1860, scientists use limited temperature records, along with proxy indicators such as tree rings, pollen records, and analysis of air frozen in ancient ice.

The solar energy received from the sun drives Earth's weather and climate. Some of this energy is reflected and filtered by the atmosphere, but most is absorbed by Earth's surface. The absorbed solar radiation warms the surface and is re-radiated as heat energy into the atmosphere. Some atmospheric gases, called



*ARM Facilities Newsletter* is published by Argonne National Laboratory, a multiprogram laboratory operated by The University of Chicago under contract W-31-109-Eng-38 with the U.S. Department of Energy.

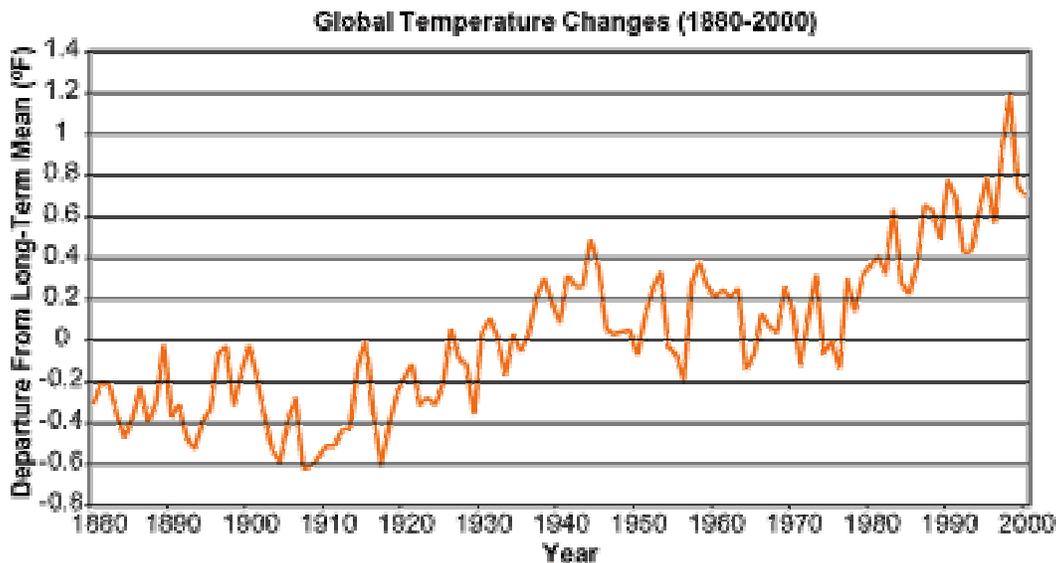
*Technical Contact:* James C. Liljegren

*Editor:* Donna J. Holdridge

greenhouse gases, trap some of the re-emitted heat, keeping the surface temperature regulated and suitable for sustaining life.

Although the greenhouse effect is natural, some evidence indicates that human activities are producing increased levels of some greenhouse gases such as carbon dioxide, methane, and nitrous oxide. Scientists believe that the combustion of fossil fuels is responsible for the increased levels of carbon dioxide in the atmosphere.

coastal areas. A few degrees of warming might lead to more frequent and severe heat waves, worsened air pollution with adverse effects on human respiratory health, and wider spread of tropical disease such as malaria. The world's hydrologic cycle might be affected by an increase in evaporation and, thus, in precipitation. An increase in evaporation will increase atmospheric water vapor, a significant natural greenhouse gas. The increase in water vapor might further enhance the global warming caused by the greenhouse effect. This is known as a



Source: U.S. National Climatic Data Center, 2001

According to the EPA, the burning of fossil fuels for cars and trucks, the heating of homes and businesses, and the operation of power plants account for approximately 98% of U.S. carbon dioxide emissions.

The increase of greenhouse gases will, theoretically, enhance the greenhouse effect by trapping more of the heat energy emitted by Earth's surface, thus increasing the surface temperatures on a global scale. Scientists expect that the global average surface temperature could rise 1-4.5°F in the next 50 years and as much as 10°F in the next century.

Global warming could potentially have harmful effects on human health, water resources, forests, agriculture, wildlife, and

positive feedback. The increase in water vapor could also change the amount of clouds present in the atmosphere, which could reduce temperatures in a negative feedback.

Many interrelated factors affect the global climate and are responsible for climate change. Predicting the outcome of the interactions among the many factors is not easy, but it must be addressed. The ARM Program is taking a lead in this effort by collecting vast amounts of data whose analysis will improve our forecasting models for both daily weather and long-term climate. For more information on the ARM Program, please visit our web site at [www.arm.gov](http://www.arm.gov).