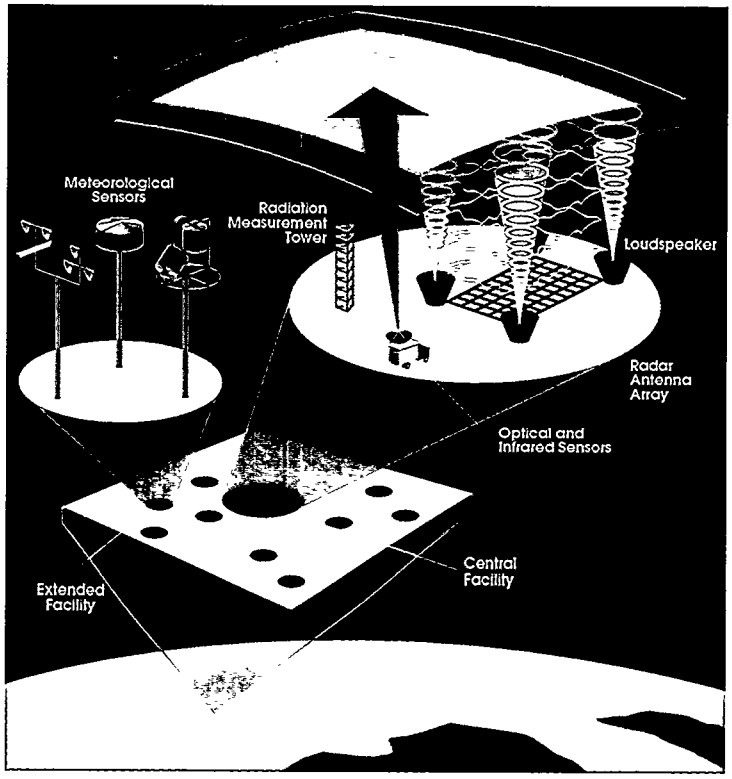
**1959** Wallace Broecker at Columbia University used natural radiocarbon in the ocean to quantify ocean circulation processes.

**1960** In advance of the proposed use of nuclear explosions to excavate a harbor near Cape Thompson, Alaska, AEC-sponsored scientists began an exhaustive ecological survey of the area. This "environmental assessment" predated by almost a decade the requirements of the National Environmental Policy Act of 1969.

**1960** University of Wisconsin scientists used radiosodium and radioiodine to document the physical and biological mechanisms of material mixing and transport in a chemically stratified lake.

**1961** Researchers at Oak Ridge developed a specific-activity methodology to estimate the bioaccumulation of radionuclides in terrestrial and aquatic organisms. The following year they would introduce the first analog models to simulate the distribution, cycling, and fate of radionuclides in ecosystems.




**ARM'S REACH** OBER's Atmospheric Radiation Measurement program will provide a firmer foundation for computer models used for atmospheric research and climate predictions. Data are being acquired from three Cloud and Radiation Testbed (CART) sites, located in the southern Great Plains, on the North Slope of Alaska, and in the western Pacific. Each CART site consists of a central facility and smaller clusters of instruments deployed over an area of 22,500 square kilometers.

Over the past two decades, the DOE has tackled some of the central tasks in global climate research. One has been to examine the global carbon cycle, quantifying by way of modeling and measurement all significant natural sources and sinks of $CO_2$, as well as those attributable to human activity. One of the key figures in this area was Oak Ridge's Jerry Olson, who was among the first researchers to identify the importance of carbon exchange between terrestrial ecosystems and the atmosphere. A second task has been the continuous refinement of GCMs as tools for simulating climate dynamics and for predicting climate change. Using one such model, Warren Washington estimated in 1984 that a doubling of atmospheric $CO_2$ levels would produce a global temperature rise of 4 degrees Celsius. This remarkable early prediction has been revised only slightly, to 1.5–3.0 degrees Celsius, despite the availability today of far more elaborate models.

Yet another task was the continuing challenge of measurement. In 1989 the government launched the U.S. Global Change Research Program, an ambitious multiagency effort to focus on global environmental change and its impacts. The DOE responded by establishing the largest surface-based research program among the U.S. climate research efforts, the Atmospheric Radiation Measurement (ARM) program. This multi-institutional effort strives to quantify the fate of solar radiation interacting with clouds and falling on the earth and to capture that knowledge in improved atmospheric models. Some fundamental questions drive the effort: How much solar energy is reflected or absorbed by clouds and atmospheric aerosols? How much is reflected or absorbed at the earth's surface? And how much is returned to space as heat? Only by understanding these processes can we hope to further refine models of the earth's climate and thus reconstruct the past and more confidently predict the future. Accordingly, the ARM sites represent the most intensively measured volumes of the atmosphere ever maintained for an extended period.

Today, global climate change research continues as a vigorous multiagency priority, propelled by the issue's overarching importance and challenged by the profound complexity of atmospheric and biological processes. The DOE is now one of several federal agencies, notably NASA, the National Science Foundation, and the National Oceanic and Atmospheric Administration, working as partners to predict future concentrations of greenhouse gases, to assess