magnitude of the effect of air pollution on health. In addition, the function was selected by the Office of Technology Assessment for use in estimating the health effects of sulfur dioxide emissions.

Benefits Concern about the health and environmental impacts of sulfur dioxide emissions has been evident in bills placed before the United States Senate. One such bill required a reduction of sulfur dioxide emissions from about 22.5 million to 12.5 million tons/year in the states bordering on and east of the Mississippi River (a reduction of about 45 percent of 1980 emissions), while another required a total emissions reduction of about 8.2 million tons annually in these states. Although these bills were aimed primarily at reducing the environmental damage caused by acid rain, they also have implications for human health. In response to these bills and hearings on revision of the Clean Air Act of 1970, the Office of Technology Assessment prepared a technical report for Congress on sulfur dioxide emissions. The health impacts portion of that report is based on the probabilistic sulfate/particle damage function. The cost of the emissions reductions specified in the first bill was estimated to range from $3.9 billion to $4.9 billion/year (1981 dollars) and the cost of the second bill to range from $2.6 billion to $3.1 billion/year. In a separate study the Congressional Budget Office estimated that simply maintaining current sulfur dioxide emissions standards would cost $36.5 billion (1981 dollars) in capital costs and $15.4 billion in annual operating costs.

To bring these numbers into perspective, the probabilistic sulfate damage function was used to estimate the health impacts of both bills. The reduction in excess deaths that might result from a reduced level of emissions was calculated along with the investment costs required to meet the reduced levels. The cost per death averted was found to vary in the 90 percent confidence range, from $59,000 to infinity, with the median at $180,000 to $230,000.

With a method available to quantify potential sulfate health effects, both proponents and opponents of emissions-control legislation are able to generate widely varying, but defensible health-impact estimates to support their respective positions. General acceptance of the probabilistic damage function enables decision makers to place extreme estimates in perspective and provides them with a common basis for comparing alternate regulatory options and approaches.

Responding to Hazardous Events Events in recent years, such as the reentry of Cosmos 942 and the atmospheric testing of nuclear weapons by foreign powers, have led to the development of a capability to react to such possible emergencies and evaluate their consequences. Two complementary systems that provide such a capability were developed under the OHER research program and are operational today. Both were initiated in the 1960s because of concern about fallout from atmospheric testing of nuclear-weapons.

Atmospheric Release Advisory Capability The ARAC is a validated system for predicting the transport and dispersion of substances released into the atmosphere. ARAC provides real-time analysis and interpretation of the dispersal of atmospheric releases of potentially harmful substances that are used to support on-site decisions. Output containing position- and time-dependent concentrations is provided by telephone lines to user terminals, telecopiers, and computers.

ARAC can independently predict the dispersion of materials released simultaneously from several locations. The real-time estimation results from a prediction of the concentration of the toxic material in the atmosphere. ARAC includes (1) the ability to use a variety of dispersion models that range from complex to simple; (2) the capability to include terrain effects; (3) a centralized computer facility with access to terrain data for any location in the United States; (4) the ability to use terrain information from outside the United States; and (5) access to real-time data on local weather conditions and winds aloft.

Inputs to ARAC are (1) the types of substances released, (2) the quantities of material released over time, and (3) the altitude of the release. If these factors are not known quantitatively, preselected approximations can be used in calculations. With these inputs, supplemented by current meteorological data and the internal terrain data base, ARAC can initiate its predictions. The ARAC system is activated through direct requests from ARAC sites and through DOE headquarters for non-ARAC sites.

Those users who are directly connected to the ARAC system are able to make faster and more accurate predictions. User costs vary according to equipment availability, software, and interface but generally range from $10,000 to $55,000 (not including manpower costs) for initial installation and 4 to 5 months of operation.

History The ARAC project was initiated as a result of AEC's concerns regarding the fate of radioactive debris from nuclear tests in the 1960's. Originally, the project focused on fallout and long-range transport and diffusion (thousands of kilometers) to ensure that the United States did not violate international agreements by nuclear debris from the Nevada Test Site crossing National boundaries. This capability was improved, verified by measurements, and expanded to include real-time predictions.

In 1972 the AEC decided to develop a real-time assessment capability for accidental radioactive releases from industry. The ARAC project was initiated by Lawrence Livermore National Laboratory (LLNL) in 1973. Currently, ARAC is being upgraded to state-of-the-art technology, and the staff is expanding to 24-hour coverage for Federal and state emergency response support.