DEPARTMENT OF ENERGY AND NATIONAL NUCLEAR SECURITY ADMINISTRATION (NNSA) OPERATIONAL AND RESEARCH WEATHER PROGRAMS

For almost 60 years, the Department of Energy (DOE) and its predecessors, the Atomic Energy Commission (AEC) and the Energy Research and Development Administration (ERDA), have established and supported meteorological operations and atmospheric research at the DOE field facilities. The need for meteorological services began in 1944 with the development, fabrication, and testing of atomic weapons and their accompanying national security and safety issues. Meteorological program requirements were subsequently augmented, starting in the late-1960's, by the passage of environmental protection legislation under the Clean Air Act, which is enforced by the Environmental Protection Agency (EPA) under 40 CFR enabling regulations, and reinforced by several DOE Orders that specify requirements for meteorological services to protect public health and safety and the environment. Consequently, a meteorological monitoring program has become an even more essential component of each DOE site. Moreover, the acquisition of quality-assured meteorological data and the provision of weather forecasting services is an important element of a DOE Integrated Safety Management System (ISMS). It significantly contributes to the implementation of site-wide personnel safety programs along with site evaluations. These evaluations include, but are not limited to the following: protection of facility workers and the public; development of Authorization Basis (AB) safety documentation; diagnostic and prognostic consequence assessment elements of an emergency management system; preparation of permits to support environmental compliance activities; and, impact analyses of construction and operation of projects and missions requiring National Environmental Protection Act (NEPA) determinations.

OVERVIEW OF DOE AND NNSA OPERATIONAL METEOROLOGICAL PROGRAMS AND SUPPORTING RESEARCH

Recognition of the need for site-specific meteorological services began more than 60 years ago in 1944, with the development, fabrication, and testing of atomic weapons and their accompanying national security and safety issues. In response to this need, the Department of Energy (DOE) and its predecessors, the Atomic Energy Commission (AEC) and the Energy Research and Development Administration (ERDA), as well as the National Nuclear Security Administration (NNSA) in the present, have established and supported operational meteorological programs and atmospheric research projects at many DOE and NNSA field sites.

Operational meteorological program requirements were subsequently augmented, starting in the late-1960's, by the passage of environmental protection legislation under the Clean Air Act (CAA), enforced by the Environmental Protection Agency (EPA) under 40 Code of Federal Regulations (CFR) enabling regulations, and reinforced by several DOE Orders (e.g., O 231.1) that specify requirements for meteorological services to protect facility worker health and safety, public health and safety, and the environment. Since that time, the CAA has been amended on three occasions, each time including broader requirements, inclusive of stratospheric ozone protection regulations. Consequently, an effectively managed meteorological monitoring program has become an even more essential component of each DOE and NNSA site. Moreover, the acquisition of quality assured meteorological data, the provision of weather forecasting services, and the development of site-specific climatology from these meteorological programs is an important element of a DOE Integrated Safety Management System (ISMS), since it significantly contributes to the implementation of site-wide personnel safety programs and supports multiple evaluations. These evaluations include, but are not limited to the following:

- Protection of facility workers and the public;
- Development of nuclear and chemical safety documentation (e.g., Safety Analysis Reports (SAR) and Documented Safety Analysis (DSA));
- Diagnostic and prognostic consequence assessment elements of an emergency management response system;
- Preparation of air, surface water, ground water and waste management permits to support environmental compliance activities; and,
- Impact analyses for construction, operation and decommissioning of projects, and missions requiring National Environmental Protection Act (NEPA) determinations.

DOE and NNSA continue to address their fundamental mission areas of national security, science and technology, energy security, safety and health,

and environmental quality. Meteorology and the atmospheric sciences contribute to the successful implementation of many of these mission elements. Consequently, atmospheric science research programs, meteorological data acquisition programs, analytical assessments requiring meteorological information, and weather forecasting operations have been an integral part of DOE, NNSA and its predecessor agencies since World War II. World-wide energy production is modifying the chemical composition of the atmosphere, which is linked not only with environmental degradation and human health problems, but also with changes in the most sensitive parts of the physical climate system. The Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment Report (AR4) recently assessed how the Earth system's energy balance has been and will be affected, thus underpinning the importance of continual monitoring of the atmosphere.

DOE administers programmatic activities throughout its various offices, such as the Offices of Science (SC), Health, Safety and Security (HS), and Environmental Management (EM) that have some linkage to the atmospheric sciences. NNSA administers the nation's nuclear weapons and non-proliferation programs, and includes the National Atmospheric Release Capability (NARAC) in its nuclear weapons incident response program. Some of these program offices are responsible for the management of scientific research programs, such as Global Climate Change Research (GCCR), and various environmental cleanup activities at former DOE production sites. Additional activities at DOE and NNSA sites include support to daily operations and national defense programs; all of which require a fundamentally sound well-managed meteorological monitoring program.

Meteorological services at DOE and NNSA facilities range from the conduct of cutting-edge basic research to providing daily support to operational programs and construction projects. Some examples of research and development are investigations of potential global climatic change, radiation transfer mechanisms and cloud studies, lightning and thunderstorm studies, atmospheric chemistry, atmospheric tracer studies, and studies of atmospheric planetary boundary layer processes. Operational support programs include daily-customized weather forecasting services, support to national defense projects and homeland security, onsite meteorological monitoring programs, climatology services, occupational health and safety program support, and emergency preparedness and response program support.

Some DOE and NNSA sites maintain 24-hour weather watches for severe weather conditions that have the potential to impact site operations, damage property, or threaten lives. DOE-wide and NNSA-wide lightning safety initiatives, which are becoming integral elements of ISMS, are supported by DOE and NNSA operational meteorological programs (e.g., Nevada Test Site [NTS], Hanford, Savannah River Site [SRS], Idaho National Laboratory [INL]).

Several DOE and NNSA field offices and their associated sites and facilities cover large areas (e.g., INL, Oak Ridge Reservation [ORR], NTS, Hanford, and SRS). In addition, several DOE and NNSA sites are situated in areas of complex topography and heterogeneous surface characteristics (e.g., land-water interface), creating mesoscale conditions that locally influence onsite weather and more importantly, airflow trajectories associated with atmospheric transport and dispersion.

For these reasons, and to ensure the protection of public health and safety and the environment, onsite meteorological monitoring programs have been, remain, and will always be an essential part of DOE and NNSA atmospheric science programs. Moreover, partnerships have been forged with other Federal agencies (i.e., Department of Defense [DOD], Department of Transportation [DOT], Department of Commerce [DOC], Department of Agriculture [DOA], Department of Interior [DOI] and the National Aeronautical and Space Administration [NASA]). In some cases, Interagency Agreements (IA) have been developed with other Federal agencies (e.g., NTS), and have been in place for more than 45 years.

Some DOE and NNSA sites enhance the spatial resolution of the National Weather Service (NWS) observing network by taking standard surface and upper-air observations. Many of these sites are in remote areas where NWS and community weather observations would otherwise be limited. Weather observations taken at a few DOE and NNSA field sites are entered into the database via the NWS meteorological data distribution and display system. This distribution and display system interconnects field offices and serves as the distribution system for NWS meteorological products that are centrally produced by the National Centers for Environmental Prediction (NCEP). Some DOE and NNSA sites [e.g., NOAA Air Resources Laboratory (ARL)/Special Operations and Research Division (SORD), Las Vegas, NV] employ the National Oceanic and Atmospheric Administration (NOAA) Advanced Weather Information Processing System (AWIPS), as well as vertical profilers and meteorological monitoring networks.

An accidental release of radioactive, chemical, or biological toxic material into the atmosphere can have potentially serious health effects, as well as environmental consequences. Meteorological transport and dispersion

processes play a key role in determining the fate of radioactive, chemical, or biological agents released into the atmosphere; including those resulting from malevolent acts. Consequently, a central theme within the DOE and NNSA community has been to protect public health, safety, and the environment on and around DOE and NNSA facilities by accurately measuring and characterizing the important local atmospheric processes necessary to characterize atmospheric transport and dispersion.

In recognition of the aforementioned needs and requirements, DOE and NNSA have established and continue to support onsite meteorological monitoring programs since the commissioning of an operational meteorological program in 1944 at Hanford. Each meteorological program is primarily directed towards the support of emergency preparedness and response programs and focused towards the protection of the environment and the safety and health of the onsite work force and the public. In addition, research on the modeling of the transport, dispersion, deposition, and resuspension of radioactive, chemical, and biological agent materials is undertaken to refine the transport and dispersion models used in these endeavors. New remote sensing techniques are being developed, such as the "Best" Aircraft Turbulence probe at the ARL Field Research Division (FRD), in Idaho Falls, ID. Onsite weather forecasting services, each tailored specifically for the special operational and emergency management requirements at each DOE and NNSA site, provide necessary support to the safety and health programs designed to protect site personnel, the public, and the environment.

A large majority of the research and operational support has been provided by the atmospheric research programs at the five major offices directly involved in national defense programs. Over the years, these programs have grown to address and support many environmental, safety, and health issues. Due to the complexity of these activities, it was recognized that efforts should be made to coordinate meteorological operations and research among the field offices to enhance cost effectiveness and productivity. To address these considerations, the DOE Meteorological Coordinating Council (DMCC) was formed in 1994 and has been providing support to DOE and NNSA meteorological programs for over 10 years.

The following narrative highlights the DMCC and the meteorological activities at 14 separate DOE and NNSA sites. These activities are subdivided into operational and research components.

DMCC

Based on a need to facilitate more coordination and cooperation among the meteorological activities at the DOE field offices, the DMCC (i.e., the Council) was established on December 2, 1994, in Las Vegas, NV, under the direction and oversight of NNSA's Nevada Site Office. Its central focus is to coordinate activities of the meteorological programs that exist throughout the DOE and NNSA in the absence of such function anywhere within the DOE organization.

In April, 2004, the DMCC program was integrated with other programs associated with the Emergency Management Issues Special Interest Group (EMI SIG) under the oversight DOE Office of Emergency Management (OEM).

The DMCC objectives are to:

1. Promote cost-effective support for all DOE facilities;
2. Facilitate the use of common methods, procedures, and standards;
3. Plan for future needs, requirements and missions; and,
4. Advocate awareness of atmospheric science applications and benefits to DOE.

The DMCC accomplishes its objectives by using the following methods:

1. Encourage interchange of technical information between DOE offices;
2. Foster the development of atmospheric monitoring equipment and systems;
3. Acquire and disseminate atmospheric data products to meet Departmental needs and requirements;
4. Promote consistency of monitoring and assessment products and services;
5. Interface with appropriate agencies, academics, and professional organizations;
6. Make recommendations on equipment procurements, replacements and modifications to benefit DOE operations; and,
7. Provide consultation and technical assistance to foster cooperation and research among the DOE meteorological programs.

Council oversight is provided by a steering committee consisting of DOE and NNSA headquarters and field element representatives (i.e., NA, HS, and SC).

The DMCC conducts technical/business meetings on a periodic basis and also conducts site-funded Assist Visits. The technical/business meeting, assist visits, and other activities are focused on helping DOE meteorological program managers and their staff of meteorologists to effectively execute their mission of protecting the health and safety of DOE workers and the public.

The DMCC also supports activities of the OEM, the Office of Health, Safety and Security, and the Office of Science. DMCC works with similar Departmental groups to improve the provision of quality-assured meteorological information and execution of transport and dispersion models that meet Software Quality Assurance (SQA) requirements.

Products of the DMCC include eval-

uations of meteorological requirements contained in DOE orders and guidance documents, site meteorological program peer reviews, and, as needed, customized technical assistance. Assist Visits have been conducted at NNSA/Nevada Site Office (NSO), Waste Isolation Pilot Plant (WIPP), Pantex, DOE/Oak Ridge Reservation (ORR), Sandia National Laboratory (SNL)-Albuquerque, Y-12 and Idaho National Laboratory (INL). Three follow-up assist visits were also conducted at WIPP, the latest in 2005. Additional assist visits are in the planning stages and will be conducted over the next several years.

The DMCC membership, which encompasses subject matter experts (SME) within the DOE complex, involves three specific components:

- Department of Commerce (DOC) captive contractors under an Interagency Agreement (IA);
- Management & Operating (M & O) contractors; and,
- Private contractors.

Dr. Darryl Randerson, National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory/Special Operations and Research Division (ARL/SORD) has served as the DMCC Chairman since its inception.

DOE has delegated the operation of its site/facility meteorological programs to captive DOC contractors and non-Federal for-profit M & O contractors.

The DMCC web page has been broadened and can be accessed at www.sord.nv.doe.gov. As part of the NA-41 Emergency Management Issues Special Interest Group (EMI SIG) program, DMCC can also be accessed through the web page of the Subcommittee for Consequence Assessment and Protective Actions (SCAPA).

ARGONNE NATIONAL LABORATORY (ANL)

Operational

Argonne National Laboratory (ANL) is one of the largest research centers that is associated with DOE. It is also the nation's first national laboratory, chartered in 1946. ANL is managed and operated by the University of Chicago (UC) for the DOE Chicago Operations Office. Argonne occupies two sites, designated as ANL-East in Illinois and ANL-West in Idaho. The Illinois site is surrounded by forest preserve on 1,500 wooded acres about 25 miles southwest of Chicago's Loop. The site also houses the DOE Chicago Operations Office. Argonne-West occupies about 900 acres about 50 miles west of Idaho Falls in the Snake River Valley. It is the home of most of the ANL major nuclear reactor research facilities.

There are three divisions, Environmental Research (ER), Decision and Information Sciences (DIS) and Environmental Assessment (EAD) at ANL with meteorological research or operational program support. Two cross-divisional groups are involved in these programs at ANL: the Atmospheric Research Section (ARS) and the Atmospheric Emergency Preparedness (AEP) Group. The ARS is composed of scientists doing research activities in both basic and applied science; particular technical strengths are in the areas of air-surface exchange, remote sensing, atmospheric chemistry, and numerical modeling. About half of the ARS support is currently devoted to activities associated with the DOE Atmospheric Radiation Measurement (ARM) Program. The AEP is composed of scientists and engineers in two divisions involved in programs with a greater emphasis on applied science. Particular technical strengths include air pollution meteorology, emergency preparedness and response, and stochastic systems simulations. More than half of the AEP support is associated with the DOE PROTECT Critical Infrastructure Program involving chemical and biological agents.

ARS has operated and maintains a 200-ft meteorological tower and supplies meteorological data for emergency response, facility operations, and regulatory compliance for ANL operations. Wind and temperature measurements are taken at the 33-ft and 200-ft levels. Real-time and historical data are available via the Web (http://gonzalo.er.anl.gov/ANLMET).

Research

As part of a larger program for the protection of subway systems from terrorist attacks using chemical agents, AEP is installing sonic anemometers as well as temperature and pressure sensors in the subway tunnels of a large urban subway system. These instruments will assist in the understanding of flows in the tunnels, which are driven by a combination of:

- The "piston" action of train motion; and,
- Buoyancy effects and aboveground forcing.

Measurements from these instruments will be correlated with the above ground measurements to develop and validate predictive and emergency response models for flow and dispersion in subway systems.

The AEP group research also focuses on the analysis of routinely measured meteorological data to provide atmospheric boundary layer turbulence information for atmospheric dispersion calculations. Under the Department of the Army Chemical Stockpile Emergency Preparedness Program (CSEPP), ANL provides support to improve the collection efficiency and quality of meteorological data measured at the Army's Demilitarization towers. The data are used the emer-

gency operation centers in support of emergency response exercises and for use in real-time in the event an actual accident. The goal of the CSEPP support is to improve the accuracy and robustness of the data obtained from the meteorological monitoring stations and to develop unified quality control and analyses procedures of the data collected by the towers.

Key support is also provided to Department of Transportation (DOT) in applying an ANL-developed 5-year meteorological database for over 100 locations in the United States to conduct statistical analyses of hazardous materials incidents on a national basis. Recent work for DOT has centered on development of the *Table of Initial Isolation and Protective Action Distances* for the *2000 Emergency Response Guidebook.* Protective Action Distances are given in the Table for over 200 toxic-by-inhalation chemicals and generic compounds for both daytime and nighttime accidents, and represent the safe distance for 90 percent of hazardous materials transportation accidents considering variability in meteorology and spill size. Recent work for DOT has also involved conducting national risk assessments for transportation of certain high volume toxic chemicals like chlorine, ammonia, hydrogen fluoride and sulfur dioxide.

The Atmospheric Boundary Layer Experiments (ABLE) is one of several DOE supported research programs conducted by the ARS. ABLE is located on the lower Walnut Watershed, mostly in Butler County east of the city of Wichita, KS. This location is within the existing boundaries of the DOE ARM Southern Great Plains (SGP) Clouds and Radiation Test-bed (CART) site. The establishment of this facility offers a virtual atmospheric observatory and provides essential research tools for addressing a myriad of unresolved fundamental questions in atmospheric research. The ABLE provides a continuous view of processes in the lower atmosphere over a limited domain within the SGP CART site.

The initial focus of the ABLE is measurements of the planetary boundary layer (PBL) where almost all interactions between the atmosphere and humans take place. Many scientific issues may be addressed by use of such a facility, including:

- Natural disaster reduction and public safety;
- Safe and efficient aviation and other transportation;
- Agriculture;
- Water resource management;
- Effective energy production, use and environmental protection;
- Space flight operations;
- Defense; and,
- Related areas of earth science.

Instrumentation at the ABLE site includes winds, temperatures, moisture, surface net radiation and soil moisture as the minimum set of atmospheric observations.

The initial set of equipment, which is be available at the ABLE includes:

- Three 915 MHz RWP-RASS (wind speed and direction, virtual temperature profiles);
- Three minisodars (wind and turbulence profiles between heights of 33 ft and 656 ft);
- One lidar ceilometer (cloud base height);
- One balloon-borne sounding system (wind, temperature, moisture profiles);
- Five surface flux stations (surface sensible and latent heat, ground heat storage);

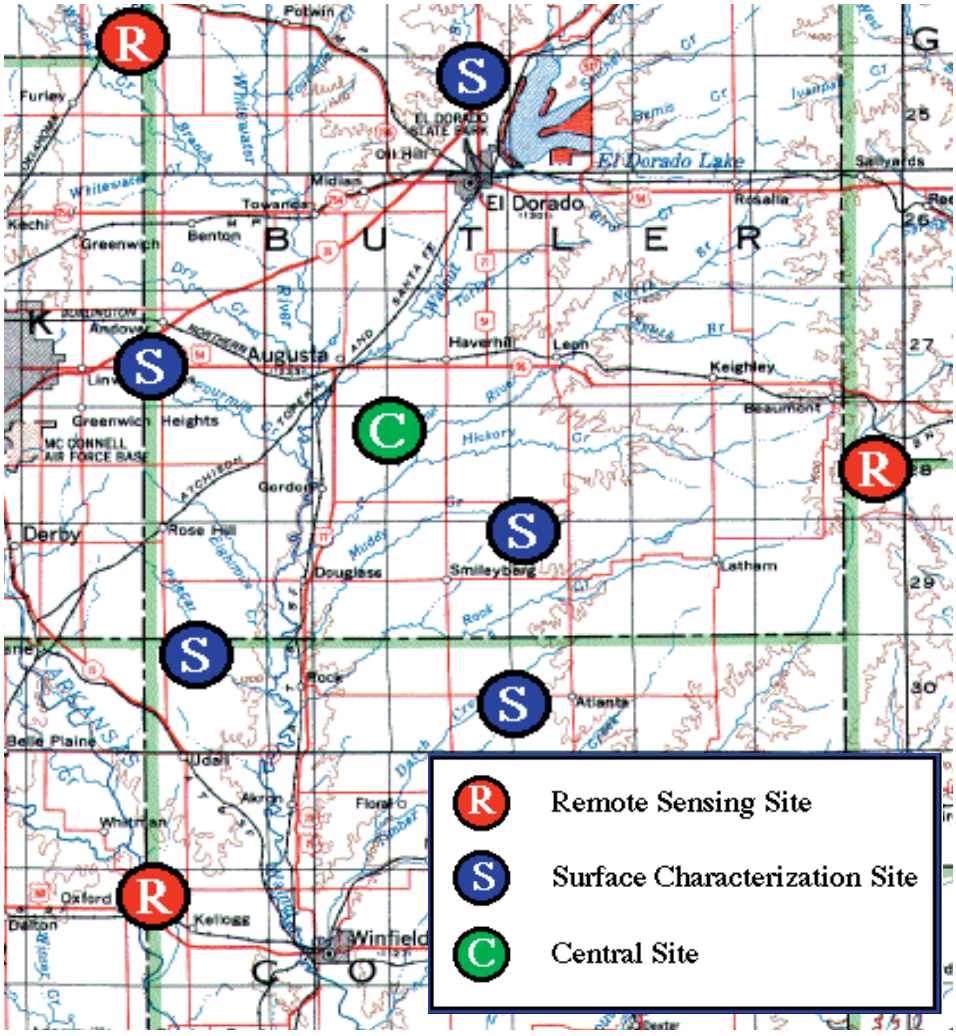


Figure 3-DOE-1. DOE Atmospheric Boundary Layer Experiment (ABLE) site locations in the Midwest.

• Five soil moisture sampling stations (soil moisture, soil temperature);
• One satellite data receiver-processor;
• One data hub/central location for data collection; and,
• One (extra) instrument pad for visiting scientist instrument accommodation.

BROOKHAVEN NATIONAL LABORATORY (BNL)

Operational

The BNL, under the responsibility of the Brookhaven Site Office, has been active in both operational meteorology and atmospheric sciences for the past 50 years. BNL is now managed by Brookhaven Science Associates, which is a joint venture by Battelle Memorial Institute Incorporated, The Research Foundation of the State University of New York at Stony Brook, and six other core university partners. Meteorological operations and research cover a wide range of programs encompassing interpretive and theoretical studies. BNL is located near the geographical center of Long Island, New York. Long Island is glacial in origin and, as a result, has sandy soil, mostly gentle undulating contours, and a single water aquifer for the entire island. Elevations vary between 65 ft and 115 ft. The BNL site is rectangular and approximately 5,200 acres in area. Winds are predominantly southwesterly, and plume dispersion studies show that it is essential to monitor winds well beyond laboratory borders. The NWS' New York City Weather Forecast Office is located at BNL. This office has an umbrella of coverage that includes an estimated population of one million. Nearby, in Bohemia, is the NWS' Eastern Regional Headquarters that administers a 12-state region.

The mesoscale meteorological measurements necessary for emergency response are the responsibility of the Meteorological Services Group, a support group under the Department of Applied Science, Environmental Biology and Instrumentation Division (EBID).

The Meteorological Services Group maintains two meteorological towers, 10-meter and 88-meter, and an instrument shelter. By integrating redundant pairs of standard, approved meteorological sensors throughout the system, an overall data availability of better than 99 percent is achieved. The real-time data are merged into the laboratory emergency response network. A database of 50 years (in digital format since 1960), one of the longest continuous meteorological time series in the United States, is archived and is available. A real-time monitoring network with worldwide web access covers the eastern end of Long Island. Coastal weather stations at Smith Point and Orient Point transmit data each minute. Pollution-monitoring data buoys are added during field programs.

The Meteorological Services Group provides a locally tuned forecast twice daily during normal working hours. Weather forecasts and data are available by telephone or the Internet (www.weather.bnl.gov). During severe weather events updates are given every three hours and, in the case of a hazardous material or radiological release, a member of the Meteorological Services Group will assist the emergency coordinator with regular forecasts and information on local wind fields and gustiness.

Research

Areas of meteorological research at BNL include:

• Instrumentation development for field studies of atmospheric constituents, air-sea interaction, and laboratory experiments;
• Gaseous tracer studies of atmospheric transport and dispersion;
• Aerosol formation and behavior;
• Atmospheric pollution studies
• Modeling of atmospheric chemical reactions;
• Acid rain studies both in the field and in the laboratory;
• Theoretical and observational studies of radiation transfer and fluxes; and,
• Analysis of data and development of parameterizations relevant to global climate change.

The ARM Program provides the stimulus for a wide range of climate-related studies. The ARM ocean monitoring program is developing instrumentation and a broad ship- and buoy-based observational network in the tropical western Pacific Ocean. The Atmospheric Chemistry Program (ACP) provides the Atmospheric Chemistry Division's (ACD) concern with aerosol sources, transport, and fate in the global atmosphere and the overall, and the little understood impact of aerosols on global climate dynamics. The ARM External Data Center is the center for collection, archival, and dissemination of all climate-related data sets for the ARM program.

An exciting new effort in radar meteorology focuses on algorithms for cloud detection and cloud mapping using both the WSR-88D radar network and research radar. BNL is a site in the National Aeronautical and Space Administration (NASA) Solar Irradiance Network and continuous short wave absorption measurements are made here. In a related NASA study, oceanic aerosol optical depths are measured and used to validate absorption algorithms in the SeaWiFS ocean color program.

The Optical Remote Sensing (ORS)

group within the Department of Advanced Technology (DAT) is presently modifying one of its Raman lidar systems for vertical profiling of carbon dioxide. The Raman lidar instrument is a self-calibrating sensor that means that data from a variety of locations in the world can be compared. With the incorporation of a large (4.1 foot) antenna and advanced filters and detectors, a vertical profile of CO2 concentration with a precision of 1 part per million (ppm) (Note: atmospheric mean = 370 ppm) and maximum height of two to three km can be produced routinely. These profiles will support model development and validation. Importantly, comparison of CO2 concentrations collected throughout the world and over time will prove invaluable in confirming adherence to the Kyoto protocols.

maintains other capabilities that are not funded directly by DOE. ARL FRD designs, arranges, and conducts field studies as needed to evaluate the performance of transport and dispersion models over local, regional, and continental scales, and to obtain high quality databases for model improvement. An airborne geosciences program is also maintained to measure fluxes of carbon dioxide, water vapor, and other atmospheric constituents that affect climate. These interactions provide ARL FRD staff with additional insights that aid in the understanding of local meteorological phenomena.

ARL FRD operates a large meteorological monitoring network to characterize the meteorology and climatology of the INL site. The network consists of 33 meteorological towers that are deployed both onsite and offsite. The overall meteorological measurement program is designed to provide representative data for the INL to meet specific operational and potential emergency response situations. The network covers an area of approximately 15,000 square miles. Many of the towers are 49 ft tall and provide wind speed and direction at 49-ft and air temperature at 6-ft and 49-ft. Instrumentation on 15 of the 49-ft towers also measure relative humidity at 6-ft, precipitation, and global solar radiation. Barometric pressure is provided on 11 of the towers. The other three towers range from 151-ft to 249-ft in height and are instrumented at multiple levels. The sensors at all stations are scanned every second and averaged or totaled over five minutes.

The data are subsequently retrieved into the data display and archive system at the ARL/FRD office through a radio repeater located at an elevation of 8,930 ft MSL. Continuous wind and temperature profiles are obtained from a 915 MHz radar wind profiler and RASS. A Doppler SODAR supplements the wind profile at lower levels with higher resolution data. Meteorological data are quality-controlled through automated and manual processes.

INL meteorological monitoring and emergency response efforts are enhanced with the use of an ARL FRD meteorological data display and visualization program known as INEELViz. This program has been widely deployed at 50 sites on and around the INL for access by Federal, state, and Indian tribes via the Internet.

Within INEELViz, meteorological data are displayed in real-time and overlaid on maps of the local area that include political and terrain features. In addition, the local MDIFF puff dispersion model can be accessed through the INEELViz front-end and the model output can be displayed as trajectories or concentration isopleths on the INEELViz display screen. The incorporation of RSAC dose conversions permits the user to also view real-time

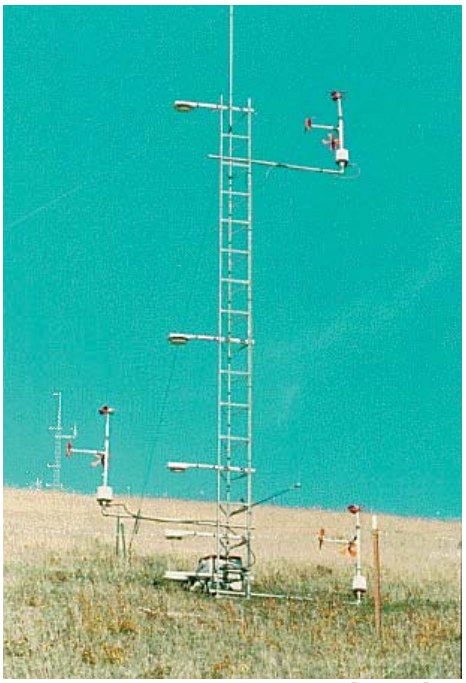


Figure 3-DOE-2. Meteorological towers record temperature and wind direction and speed at various levels.

IDAHO NATIONAL LABORATORY (INL)

Operational

INL is managed by the Idaho Operations Office and is on 890 square miles of rolling, arid terrain in southeastern Idaho at the foot of the Lost River and Lemhi mountain ranges. The primary mission of the INL for years has been nuclear reactor research with a focus on cleanup and environmental restoration. Meteorological services and supporting research are provided to INL via NOAA ARL Field Research Division (FRD). The Division, under administration from various agencies, has provided support to INEEL for over 50 years. Its current mission to DOE/ID is to support emergency response and operations with real-time meteorological data, climatology data, weather predictions, dispersion calculations, and consultation. ARL FRD

dose estimates from the model output. These features have become very useful enhancements to the INL emergency response capability.

Research

Partnerships forged with DOE/ID, the State of Idaho INL Oversight Program, and the Shoshone-Bannock Indian Tribes have resulted in additional methods of meteorological data dissemination. Meteorological and background nuclear radiation data from four public access sites on and surrounding the INL are displayed at nearby kiosks in real-time. Additional information on nuclear radiation and meteorological tutorials are presented at the kiosks. The data are also available on the Internet at http://oversite.inel.gov. ARL FRD maintains its own web site at www.noaa.inel.gov.

LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL)

Operational

LLNL is located in a valley in California's Coast Range Mountains about 25 miles east of Oakland. LLNL covers approximately 2 square miles and is operated by the University of California for the DOE Oakland Operations Office. Two groups are involved in the operational aspects of atmospheric sciences at LLNL:

1. Environmental Protection Department (EPD); and,
2. Energy and Environment Directorate (EED)

EPD operates a 40 m tower and supplies meteorological data for facility operations, regulatory compliance, and emergency response. Real-time and historical data are available at http://www-metdat.llnl.gov/.

Within EED, the NARAC supports Federal agencies with a world-wide centralized emergency response service (http://narac.llnl.gov/). NARAC scientists model the behavior of radiological, chemical, biological, and natural (e.g., smoke) materials on global, regional, or local scales. NARAC operations scientists deliver realistic real-time graphical dose and exposure assessments to emergency decision-makers to assist in the protection of populations at risk for releases of radiological and other hazardous material to the atmosphere. The Center provides simulation tools and customer products (e.g., high-resolution geographical displays of hazard areas, affected populations, health effects) as well as operational services and subject matter experts to a wide range of Federal, state, and local agencies.

NARAC's central emergency response system consists of automated continuous worldwide meteorological data acquisition, detailed worldwide terrain and geographic mapping databases, a suite of atmospheric dispersion models and source models to assess explosions, fires, spills, or other types of radiological, chemical, biological releases. The system includes a high-resolution, terrain-following, variable-gridded diagnostic meteorological model (ADAPT) and a prognostic model with parameterizations for urban settings (COAMPS) coupled with a generalized Lagrangian particle dispersion model (LODI). NARAC also provides stand-alone rapid-response models (e.g., HOTSPOT), specialized fallout models (KDFOC and LODIFOC), and SNL's explosive source prompt effects models. NARAC utilizes real-time meteorological observational data and forecast model output obtained from the National Weather Service (NOAA), the Fleet Numerical Meteorology and Oceanography Center (FNMOC) and the Air Force Weather Agency (AFWA).

NARAC provides 24/7 service 365 days/year. Supported sites and organizations can use the client-server-based NARAC iClient tool or NARAC Web tools to run models and seamlessly distribute products to multiple organizations over the worldwide web. Automated NARAC mapped products are delivered in 5-10 minutes to organizations with NARAC Web or iClient access.

NARAC supports the DOE Nuclear Incident Response Teams (NIRT), the regional Radiological Assessment Program (RAP) teams, the Aerial Measuring System (AMS), the Federal Radiological Monitoring and Assessment Center (FRMAC), the Department of Homeland Security under a DOE-DHS Memorandum of Agreement, and 40 DOE and DoD on-line sites. NARAC operational support of 5 cities and 53 state and Federal organizations across the country has been successfully tested under DHS and DOE support. The NARAC DOE/NNSA customer base and usage has increased dramatically in recent years, including a three-fold increase in the number of user base and a ten-fold increase in the number of DOE NA-40 test, drills, exercises and responses.

On April 15, 2004, the Homeland Security Council created an Interagency Modeling and Atmospheric Assessment Center (IMAAC) to consolidate and integrate the Federal efforts to model the behavior of various airborne releases into one emergency response organization for homeland security. NARAC was designated as the primary interim provider of IMAAC capabilities and is currently supporting over 350 new Department of Homeland Security (DHS) stake-

holders. The IMAAC was formally stood up by the DHS S&T Directorate in April, 2004. Under DOE or DHS direction according to the National Response Plan (NRP), NARAC supports Incidents of National Significance and National Special Security Events.

Research

Scientists in the LLNL Energy and Environment Directorate (http://eed.llnl.gov/) perform pioneering research on global and regional climate, atmospheric chemistry, and the local, urban, regional, and global transport and fate of hazardous releases to the atmosphere. Research is focused on major national energy and security policy issues and is based primarily on development and use of advanced computational simulations of the atmosphere, oceans, and biosphere.

LLNL Energy and Environment Directorate conducts research in four areas related to atmospheric science:

- Carbon cycle and climate model physics;
- Climate change & model evaluation;
- Atmospheric hazards and consequence assessment; and,
- Atmospheric transport & fate.

Major programs at EE&D include:

- Program for Climate Model Diagnosis & Intercomparison (PCMDI);
- Climate and Carbon Cycle Modeling (CCCM);
- Institute for Research on Climate Change & Its Societal Impacts (IRCCSI); and,
- NARAC/IMAAC Program.

The PCMDI mission is to develop improved methods and tools for the diagnosis and intercomparison of general circulation models (GCMs) that simulate the global climate (http://www-pcmdi.llnl.gov/). The need for innovative analysis of GCM climate simulations is apparent, as increasingly more complex models are developed, while the disagreements among these simulations and relative to climate observations remain significant and poorly understood. The nature and causes of these disagreements must be accounted for in a systematic fashion in order to confidently use GCMs for simulation of putative global climate change.

The mission of PCMDI demands that we work on both scientific projects and infrastructural tasks. Our current scientific projects focus on supporting model intercomparison, on developing a model parameterization test bed, and on devising robust statistical methods for climate-change detection/attribution. Examples of ongoing infrastructural tasks include the development of software for data management, visualization, and computation; the assembly/organization of observational data sets for model validation; and the consistent documentation of climate model features.

We now also are applying our collective expertise to support modeling studies initiated by the Intergovernmental Panel on Climate Change (IPCC). PCMDI is providing facilities for the storage and distribution of terrascale data sets from multiple coupled ocean-atmosphere GCM simulations of present-day climate as well as climate changes resulting from large transient increases in carbon dioxide. Extensive analysis of these simulations by members of the international climate community will provide an important scientific basis for the IPCC's Fourth Assessment Report on Climate Change, which is scheduled for publication in 2006.

The Climate and Carbon Cycle Modeling Group (CCCM) engages in research designed to help predict the consequences, and help minimize the adverse impacts, of human activities on Earth's climate system. Furthermore, we are a source of information and expertise on the climate system and carbon cycle, available to policy makers, DOE, other scientists, and the public. CCCM is working towards coupled simulations of the oceans, atmosphere, and land surface, incorporating both the physical climate system and the carbon cycle. The Group is the home of the simulation capability for the DOE Center for Research on Ocean Carbon Sequestration (DOCS).

Examples of recent CCCM work include analysis of:

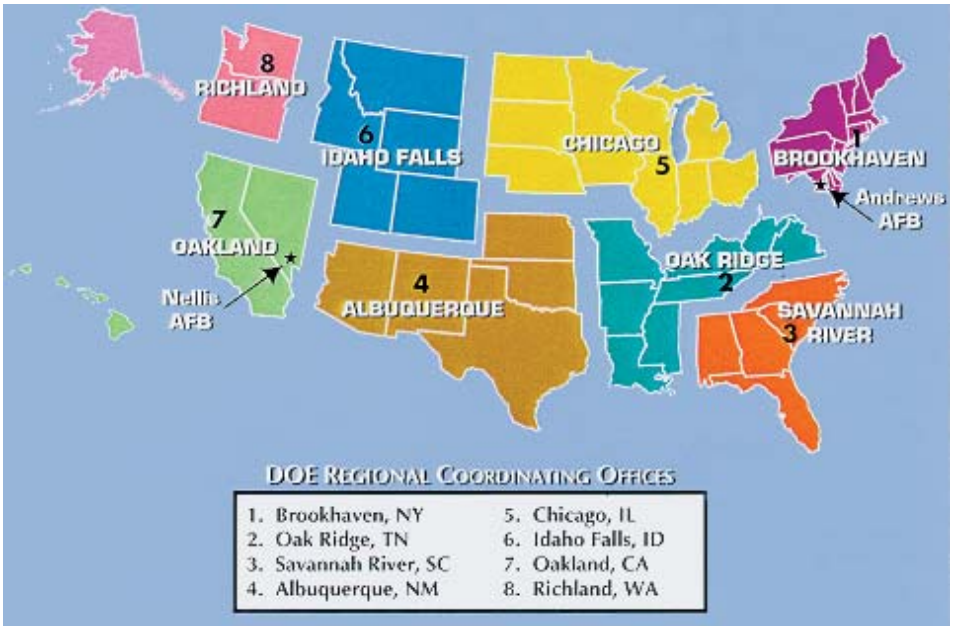
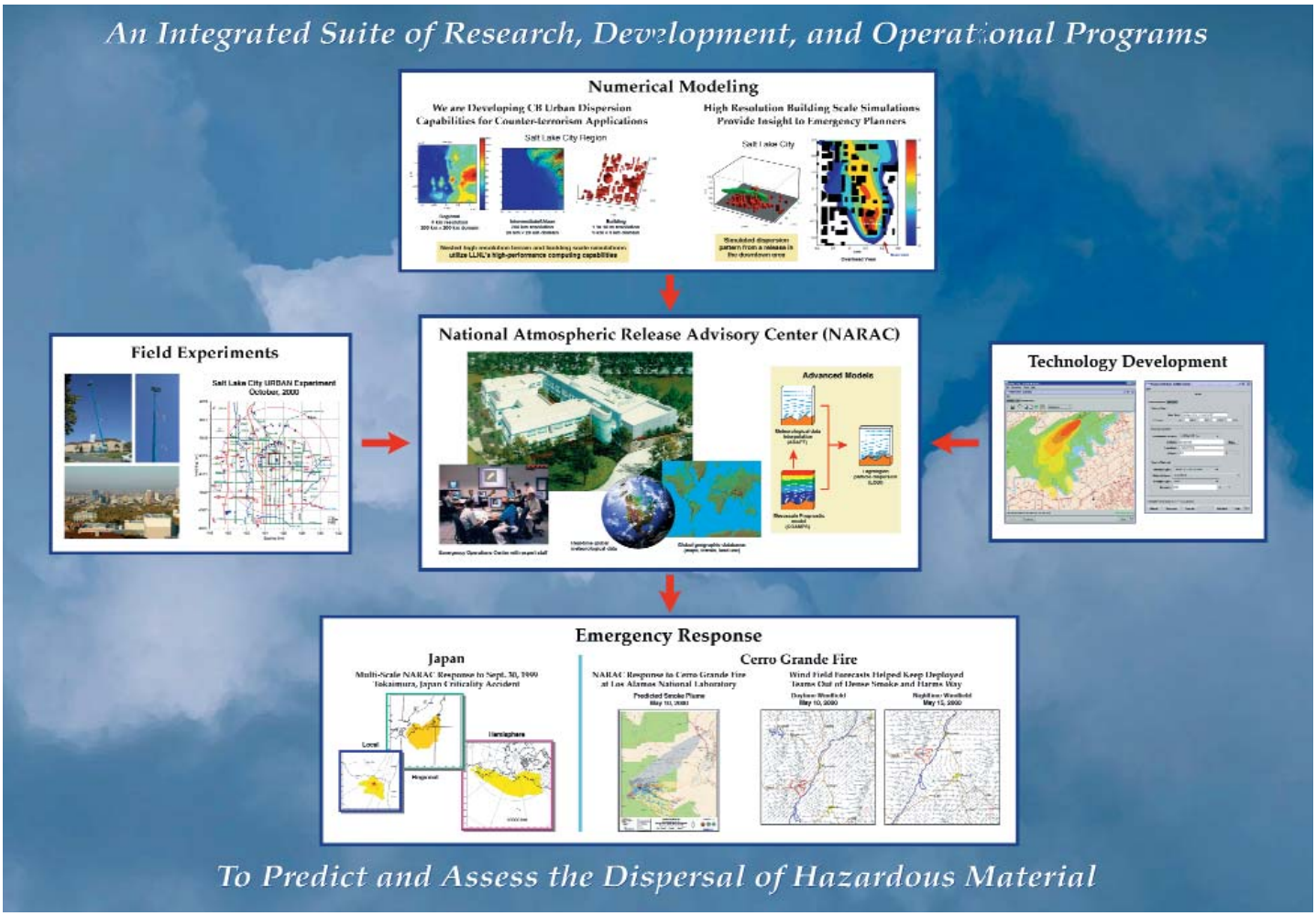


Figure 3-DOE-3. Each of DOE's eight Regional Coordinating Offices maintain a 24-hour response capability for radiological emergencies that may occur in states served by its region.



• The robustness of historical temperature trends;

• Variability in coupled ocean-atmosphere climate simulations;

• The effect of land-use changes on global temperature;

• The role of the Southern Ocean in absorbing anthropogenic carbon dioxide;

• The effectiveness of proposed geo-engineering schemes;

• The amount of carbon-free energy needed to meet global energy demand with climate stabilization;

• A proposal for storing carbon in the ocean through carbonate dissolution; and,

• The effectiveness and environmental impacts of ocean carbon sequestration options.

The mission of Atmospheric Chemistry and Aerosols Group (AC&A) is to improve the scientific understanding of the mechanisms of global environmental and climate change through the development and diagnosis of state-of-the-art models that represent key processes affecting the chemistry and microphysics of the atmosphere. We pursue this mission for the purpose of improving national energy and security policies that impact climate and environmental change.

The mission of IRCCSI is to improve understanding of climate change and its societal impacts, by facilitating collaborations between the University of California-operated DOE laboratories (i.e., LANL, LLNL, and LBNL) and University of California campuses (http://irccsi.llnl.gov/). In particular, we wish to link the Laboratories' capabilities in high-end climate modeling and climate science with the expertise in regional climate and societal impacts issues resident at the University of California campuses.

EED's Atmospheric Transport and Hazards Assessment Group support NARAC/IMAAC operations as well as supporting research. This group investigates diagnostic and prognostic tools from the building to urban to regional scales. Strategic R&D thrusts include integrating new operational capabilities, working closely with emergency planning and response user communities, and implementing improved tools to support a growing customer base.

Recent accomplishments include the following:

• NARAC co-led the Joint Urban 2003 field study (July 2003) in Oklahoma City, the largest and most complex urban tracer experiment performed to date. The study was jointly supported by DHS and the Defense Threat Reduction Agency (DTRA). Data from this study are being used to identify key urban physics issues and to evaluate the NARAC suite of urban models. NARAC is currently partici-

pating in the multi-institutional DHS/DTRA funded Urban Dispersion Program in New York City led by PNNL; and,

• NARAC is developing a multi-scale suite of models to simulate the flow and dispersion of airborne agents within urban areas. This effort is focused on the development of both a computational fluid dynamics (CFD) model, which explicitly incorporates the effects of individual buildings, and an urban canopy numerical weather-prediction model. A next-generation building-scale CFD code is being created which couples rapid geometry-to-mesh capabilities, treatment of complex building geometries, advanced numerical solvers, and parallelization. Evaluation of both models against Urban 2000 Salt Lake City and the Joint Urban 2003 Oklahoma City field study data has shown that these models can successfully simulate atmospheric transport in urban areas. Other recent accomplishments include the implementation and evaluation of time-dependent boundary conditions and the development of a significantly more computationally efficient version of the CFD model that represents outlying buildings by drag elements without significant loss of fidelity

Example of collaborative efforts with other institutions, including the following projects:

• Integration of mapping systems for field measurements, modeling results, and dose assessment to support DOE nuclear incident response capabilities, with Sandia and DOE Nevada's Remote Sensing Laboratory (RSL);

• Enhancement of source-term models for radiological, chemical, and biological releases and model for explosion prompt effects (blast, thermal, and radiation effects), with Sandia Albuquerque;

• Improved dose-response and toxic load models, with the Army's Edgewood Chemical and Biological Center;

• Development of building infiltration models to predict indoor exposures, with LBNL;

• Incorporation of an empirical urban model, with the United Kingdom (UK) Defense Science and Technology Laboratory (DSTL);

• Meteorological and outdoor dispersion modeling for an operational subway system, with Argonne National and Sandia Labs; and,

• Standardization and integration with the EPA/NOAA CAMEO/ALOHA toxic chemical databases and atmospheric dispersion models, with the NOAA Hazardous Materials Response Division.

A new multi-directorate LLNL research project is developing a data-driven event reconstruction capability to seamlessly integrate observational data streams with predictive models to provide probabilistic estimates of unknown source term parameters (location, time-varying release rate) and produce optimal situation analyses consistent with both models and data. The principal activity is focused on developing Bayesian inference and stochastic sampling methodologies coupled with a variety of predictive models to treat multiple resolutions.

Other LLNL research projects are providing improved capabilities for rain-rate and particle-size-dependent precipitation scavenging, treatment of high-altitude releases, and chemical reactions (i.e., gas and gas-aerosol) integrated into Computational Fluid Dynamics (CFD) simulations.

NARAC is exploiting rapidly developing Internet- and Web-based technology to enhance NARAC iClient and NARAC Web remote-access software that provides easy access to NARAC plume predictions. Development and deployment of these tools is key to NARAC's ability to support, manage information flow, and share a common operating picture with a large (and expanding) number of users. Upgrades include the development of pre-defined source term libraries; enhanced capabilities to support the importation, processing, and display of field measurement data; and new geographical and mapping features

The DHS Local Integration of NARAC with Cities (LINC) demonstration program has been demonstrating the value and developing approaches for providing NARAC support of local agencies. At present, five cities are participating in LINC: Seattle, New York City, Cincinnati, Albuquerque, and Fort Worth.

LOS ALAMOS NATIONAL LABORATORY (LANL)

Operational

LANL is operated by the University of California (UC) for DOE and NNSA, and is spread across 43 square miles of the Pajarito Plateau at the foot of the Jemez Mountains that extend up to around 3000 ft above the plateau. LANL is about 30 miles northwest of Santa Fe in north central New Mexico. The Pajarito Plateau slopes to the east-southeast, dropping 1300 ft across the Laboratory, with canyons and mesas running along the slope of the plateau. The broad Rio Grande Valley lies to the east of the laboratory. Los Alamos has a semi-arid, temperate, mountain climate.

The operational meteorological program at Los Alamos operates a network of six towers (ranging in height from 75 ft to 300 ft), a mono-static Doppler SODAR, and three supplemental precipitation stations. Data from four instrumented meteorological towers that are located on the Pajarito plateau drives a diagnostic wind field for the program's plume modeling capability. A fifth tower is located in Los Alamos Canyon to give informa-

tion on the larger canyons in the area, and a sixth tower is located on top of Pajarito Mountain to measure ambient conditions. The SODAR gives information on winds up to the level of the Pajarito Mountain tower.

More than 100 instruments, consisting of over 20 different types of sensors, are used to collect data throughout the network. Variables measured by the program can be grouped into the categories of wind, SODAR-derived wind, atmospheric state, precipitation-related, radiative fluxes, eddy heat fluxes, subsurface measurements, and fuel moisture. Data collected by the network are checked for quality before its archiving, and raw data and real-time displays of graphs and tables are made available via the Internet.

The LANL Air Quality Group provides regulatory and environmental surveillance leadership and services to meet LANL air quality obligations and public assurance needs. The group develops and implements programs to ensure and address institutional compliance with State and Federal laws related to air quality regulations, DOE orders for emergency management, air quality surveillance, dose assessment activities, and community concerns related to air quality issues. The group takes a proactive approach to managing air emissions by providing continuous air monitoring and measurement of external penetrating radiation onsite and offsite. The group also coordinates LANL activities to ensure full compliance with air emission regulations, providing monitoring and modeling for emergency response, and assisting operating groups in developing and implementing new methods and systems to reduce emissions to as low as reasonably achievable. The monitoring capabilities of the Air Quality Group (AQG) are supplemented by the Atmospheric and Climate Sciences Group (ACSG) field team, which operates various sensor systems including a unique Raman lidar system to obtain images of atmospheric water vapor distributions.

Research

Research within the LANL Atmospheric and Climate Sciences Group supports DOE missions in both the defense and civilian sectors, such as work in the propagation of very-low-frequency sound (i.e., infra-sound) waves. Modeling studies contributed to understanding of propagation and, in particular, sources of "infra-sound". Just as it is possible to infer earthquake epicenters from seismic wave observations, "infra-sound" sources can be inferred from atmospheric observations. This work is an important component of monitoring compliance with the proposed Comprehensive Test Ban Treaty (CTBT). The CTBT work involves a number of organizations within DOE and DOD community, including interactions with other DOE laboratories within the CTBT Research and Development program.

Operational issues involve close work with the Air Force Technical Applications Center (AFTAC) at Patrick AFB, Florida, the DOD organization that handles monitoring systems. In addition, several active international collaborations with other infrasound researchers are ongoing.

The Meteorology Team within the ACSG at LANL conducts analysis and modeling on microscale to mesoscale atmospheric flows and phenomena. In support of the DOE CBNP, a model for High Resolution and Strong Gradient (HIGRAD) applications is being used to study the effects of radiative heating and shading around groups of buildings. The objective of this study is to determine how these processes may influence the transport of agents within the urban environment. On larger scales, the team is examining the influence of flow merger and urban roughness on the vertical transport and mixing of pollutants with the Regional Atmospheric Modeling System (RAMS) for several western U.S. valleys and basins. This project is in support of the DOE Environmental Meteorology Program (EMP) and for the EPA. As part of the LANL initiative in Coupled Environmental Modeling, researchers within the Meteorology Team are developing a physics-based fire behavior model, FIRETEC, and coupling this model to the HIGRAD atmospheric dynamics code to examine the details of the interaction between local winds and the intense heat generated by wildfires. Also as part of this initiative, a land surface model is being coupled that includes hydrologic processes (i.e., SPLASH) to the RAMS mesoscale model for multi-seasonal simulations of the water resources of the upper Rio Grande Basin.

Meteorology team members are also working on the LANL Urban Security project, which is linking physical and urban growth models to address the needs of cities. In this framework, we are using the RAMS model to provide meteorological fields for use by air chemistry, urban runoff, and other models. The Meteorology team within the ACSG conducts analysis and modeling on microscale to mesoscale.

On global scales, research within the LANL meteorological community involves the study of climate change and variability. A major project is the development of a global coupled ocean-atmosphere model sponsored by the DOE Climate Change Prediction Program. The global model being developed consists of a Los Alamos global ocean Global Climate Models (GCMs) Parallel Ocean Program (POP), the Los Alamos sea-ice model (CICE), the National Center for Atmospheric Research (NCAR) Community Climate Model (CCM3), and a "flux coupler" to link the media consistently. The two GCM's and the CICE model exchange heat, momentum, and water mass across the air-sea boundary. A ten-year synchronized simula-

tion revealed the synoptic weather events, seasonal cycles and inter-annual variations.

Observations related to understanding global climate are the focus of the Tropical Western Pacific (TWP) Program Office LANL, an element of the DOE ARM Program. The TWP Program Office is responsible for the development and operation of the TWP CART locale, a large expanse of tropical-ocean and maritime-continent lying roughly between 10 degrees S and 10 degrees N latitude and from 135 degrees E to 150 degrees W longitude. The maritime continent area is largely in the southwest and the open ocean area in the northeast of the locale. The local climate is characterized by warm sea surface temperatures, deep and frequent atmospheric convection, high rain rates, strong coupling between the atmosphere and ocean, and substantial variability associated with El Niño Southern Oscillation (ENSO) phenomenon.

Scientific questions that need to be addressed in the TWP can be grouped under three main headings:

- Radiation budget and cloud forcing;
- Water and energy budgets; and,
- Ocean-atmosphere interactions.

The program supports a variety of operations at LANL. The primary client of the program is the Emergency Management Group, for which the program provides a plume modeling capability. Other clients use the program's data for such activities as operations and planning, hazard and accident analyses, environmental studies, support for experiments, compliance, and documentation.

NEVADA TEST SITE (NTS)

Operational

The NTS is managed and operated by the National Nuclear Security Administration/Nevada Site Office (NNSA/NSO). The NTS has been the

Nations' underground nuclear weapons testing facility and is now used to support sub-critical experiments and other national defense missions of the United States. The NTS occupies 1,350 square miles of south central NV and is approximately 75 miles northwest of Las Vegas, NV. The topography of the NTS is complex with a system of dry lakebeds and mountains. Elevations range from nearly 2,700 feet (ft) above mean sea level (MSL) to 7,600 ft MSL. The climate is arid.

Meteorological services are provided to NNSA/NSO by components of the Department of Commerce (DOC), NOAA. The DOC has had a presence on the NTS for more than 45 years through the implementation of Interagency Agreements (IA). During this time, NOAA personnel have built a solid technical reputation in meteorological operations and emergency response. Presently, NOAA support is provided by Air Resources Laboratory Special Operations and Research Division (ARL/SORD) recognized for its expertise in the transport, dispersion, and deposition of radioactive and toxic materials. ARL/SORD has developed a rapid emergency response capability for the unlikely occurrence of an accidental release of radioactive or hazardous material into the atmosphere.

ARL/SORD provides full meteorological support to all NNSA/NSO operations on and off the NTS. Meteorology plays a key role in environmental, safety, and health responsibilities of NNSA/NSO. The ARL/SORD staff is responsible for conducting a modern program in support of nuclear and non-nuclear projects authorized by NNSA/NSO. Furthermore, the mission of ARL/SORD involves technical support to the emergency preparedness and response activities of NNSA/NSO. ARL/SORD supports a comprehensive meteorological program on the NTS, and provides meteorological and climatology services required in supporting the NNSA/NSO and contractor programs at the NTS, and elsewhere, as necessary.

Personnel at ARL/SORD also consult with senior scientists and engineers at the DOE National Laboratories, NASA, private contractors, Desert Research Institute (DRI), United States Geological Service (USGS), United States Forest Service (USFS), and other NOAA laboratories.

ARL/SORD operates and maintains a large meteorological monitoring network (MEDA) to characterize the meteorology and climatology of the NTS. This network consists of 29 33-ft towers and two, 100-ft towers. Wind direction and speed is measured at the 33-ft level on all the towers and temperature and relative humidity is sampled at the 6-ft level. Data from these towers are transmitted via microwave radio to a central processor that checks the data, creates data files, and archives the data every 15 minutes. The data files are accessed by microcomputer to create graphics products for operational use and for immediate display at 15-minute intervals. The MEDA system was upgraded in 2004 to include sonic anemometers.

SORD also operates two, 915MHz vertical profilers on the NTS. One tower is located in the middle of Yucca Flat and the other tower is located at the Hazardous Materials Spill Center (HMSC) in Frenchman Flat near Mercury, NV. In addition, a NOAA full surface radiation (SURFRAD) budget station is operated and maintained at the Desert Rock Meteorological Observatory (DRA) located in the southern part of the NTS. Upper-air soundings are taken twice daily, at 00 and 12 Universal Time Coordinated

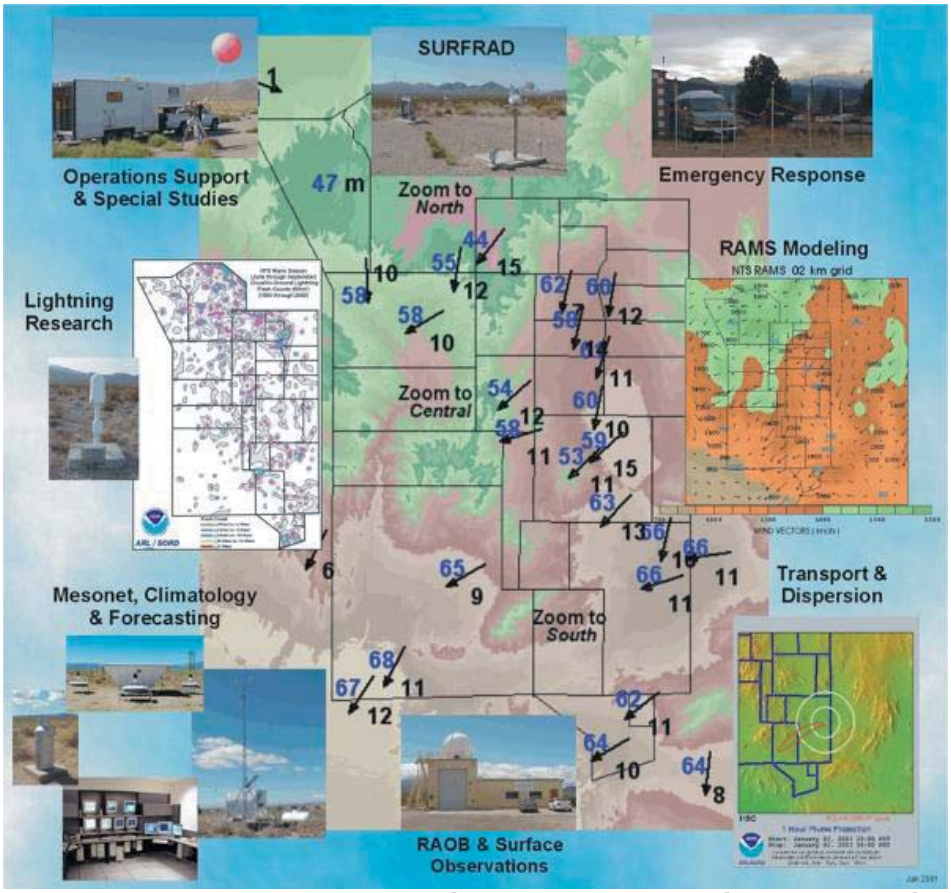


Figure 3-DOE-4. Air Resources Laboratory (ARL)/Special Operations and Research Division (SORD) conducts basic and applied research on problems of mutual interest to National Oceanic and Atmospheric Administration (NOAA) and Department of Energy (DOE), that relate to the Nevada Test Site (NTS), its atmospheric environment, and its emergency preparedness and emergency response activities.

(UTC) from the DRA facility. ARL/SORD also operates mobile upper-air sounding systems and mobile pilot balloon (PIBAL) equipment to support special projects requiring winds aloft data in real-time.

Large-scale meteorological data and National Center for Environmental Predictions (NCEP) weather forecast products are received via AWIPS, or from the University Center for Atmospheric Research (UCAR) and ARL-Silver Spring, MD. Weather products supplied to DOE contractors, the National Laboratories (e.g., SNL, LANL, and LLNL), the NWS, and Nellis AFB, include real-time cloud-to-ground lightning flash graphical products and local forecast products. Furthermore, a three-tiered lightning alert and warning procedure has been implemented as part of the NTS Integrated Safety Management program.

ARL/SORD has also implemented the RAMS model for the NTS and Southern Nevada. This model predicts boundary layer airflow and precipitation over complex terrain. The RAMS code accesses the NCEP predictive model outputs and is run twice daily at the University of Nevada at Las Vegas (UNLV) Supercomputer Center on a daily basis. In addition, the NOAA HYSPLIT/HARM dispersion model has been installed on microprocessors in the SORD Meteorological Assessment Center.

ARL/SORD provides meteorological monitoring support and project-specific weather forecast services to NEST, FRMAC and ARG activities. Monitoring support includes surface and upper-air data collection and analysis. Weather forecast service entails maintaining a constant weather watch for conditions that might impact NEST, FRMAC, or ARG operations and personnel, issuing site-specific mesoscale wind, stability, and weather forecasts, aviation weather support, and providing consultation to the On-Scene Commander (OSC) and to National Laboratories personnel. ARL/SORD maintains a web site (www.sord.nv.doe.gov) that includes graphical products that display current meteorological conditions on and around the NTS, including data from ARL/SORD vertical profilers, climatology data, cloud-to-ground lightning information and time-relevant plume transport and dispersion calculations.

Research

Both basic and applied research is carried out on problems of mutual interest to DOE and to NOAA. Emphasis is on the maintenance of meteorological support to national defense projects and to the stewardship of nuclear weapons. These capabilities focus on those facets of meteorology having a direct bearing on the transport, dispersion, deposition (i.e., fallout), and resuspension of radioactive and/or toxic materials. Other research includes documentation and study of extreme precipitation events, desert thunderstorms, cloud-to-ground lightning, and environmental issues related to air quality and visibility. In addition, the SORD program serves as a test bed for advanced NOAA mesoscale prediction models.

A NOAA Climate Reference Station was installed at the Desert Rock Meteorological Observatory in April 2004.

OAK RIDGE RESERVATION (ORR)

Operational

The ORR is home to four DOE/NNSA sites: Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex, the East Tennessee Technology Park (ETTP, formerly K-25 Site), and the Oak Ridge Institute for Science and Education (ORISE). Managed by the Oak Ridge Operations Office (OROO), the ORR encompasses nearly 100 square miles of hilly and heavily vegetated terrain in eastern TN. There are some additional SC facilities in Oak Ridge, TN.

Formerly known as the Oak Ridge Y-12 Plant, and constructed in the early 1940's as part of the Manhattan Project to manufacture nuclear weapons components, the Y-12 National Security Complex (NSC) has now assumed a national security role under the NNSA. Y-12 is an 811-acre facility located within the city limits of Oak Ridge, TN (population nearly 30,000), 10 miles from the ORNL and 12 miles from the ETTP, once known as the Oak Ridge Gaseous Diffusion Plant.

Currently operated by BWXT Y-12, the national security programs at Y-12 include manufacturing and reworking nuclear weapon components, dismantling nuclear weapon components returned from the national arsenal, serving as the nation's safe, secure storehouse of special nuclear materials, providing the U.S. Navy with safe, militarily-effective nuclear propulsion systems, and reducing the global threat from terrorism and weapons of mass destruction. In early 2004, the Y-12 NSC received, stored and secured a shipment of Libyan nuclear materials.

Meteorological network systems, which support day-to-day operations, are managed and operated at the three main sites by the University of Tennessee (UT)/Battelle, BWXT Y-12 and Bechtel Jacobs Company. These network systems provide data that support environmental management (e.g., permitting, facility siting and environmental impact assessment), facility safety (e.g., safety analyses), emergency management (e.g., hazards and consequence assessment), operations (e.g., work planning) and substantial research.

The BWXT Y-12 meteorological program is operations-, environment-, and safety-oriented. Y-12 is located in the narrow Bear Creek Valley, and it is bordered by two SW- to NE-oriented ridges, mostly covered with mature pines and hardwoods. Two meteorological towers have long formed the basis for the meteorological program. There is a 328-ft tower, instrumented at 33-, 100-and 328-ft, located on the valley floor at the East end of Y-12, and a 200-ft tower, instrumented at 33- and 200-ft, located on a ridgeline at the West end. In 2003, the data acquisition system was upgraded to an Environmental Systems Corporation (ESC) Windows-based software package, accessing via Ethernet the ESC 8832 data loggers at the towers. This data acquisition package is widely used in air pollution monitoring and in other environmental compliance applications.

Given the complex terrain setting of the Y-12 NSC, a REMTECH PA-2 SODAR is used to characterize the winds from 164-ft, extending above the surrounding ridges to a height of 1,640-ft. Redundant Windows XP polling computers collect 1-hour average SODAR data, plus 1-hour, 15-minute, and 1-minute tower data. Displays of the 15-minute data are available in the operations center, in the emergency centers, including the State Emergency Operations Center (EOC), and on an internal web page for general use by the Y-12 employees. For real-time emergency response modeling purposes, 15-minute data is also routed to the NARAC meteorological database, and to a specially-formatted file on the Y-12 EOC modeling computers. There, it is accessible by the local chemical model, CHARM®, a commercially available 3-D grid model with an extensive chemical database and source term modeling features. For most other modeling needs, the NARAC iClient model is used at Y-12, where the ridge-valley and generally complex terrain setting has represented a prototype test and demonstration site for 3-D wind field and terrain models.

In early 2006, the BWXT Y-12 meteorological program was in the early stages of a major change as a result of the 328-ft East Tower being displaced by a new "public interface facility". After 20 years of continuous operation near the Y-12 entrance, the East Tower is in the process of being dismantled. The nearby REMTECH PA-2 SODAR has illustrated that a 328-ft tower is replaceable, and by upgrading the REMTECH to a new Atmospheric Systems Corporation (formerly Aerovironment) Model 3000, there will continue to be a reliable monitoring capability to 100-meters and beyond. In addition, a shorter free-standing tower is scheduled for installation closer to the area of Y-12 operations where it will better represent 3-D turbulence parameters nearby the source of any hazardous releases.

There is no on-site weather forecasting service at Y-12, but since it is in the city limits of Oak Ridge, representative forecasts are readily available from the local media, the national network services, and the Internet. Local severe weather advisories and warnings are issued by the nearby NWS Office at Morristown, TN, and they are received and disseminated by the Plant Shift Superintendent (PSS) Office at Y-12. Also available to the PSS is a subscription weather and doppler radar

service, as well as lightning detection and prediction equipment. The Y-12 Meteorologist and a Systems Hardware/Software Engineer maintain the program, train and assists others, as needed.

The meteorological data acquisition program at ETTP has two main towers. K-1209 is 200 ft high while K-1208 is 100 ft in height. In addition, two 33-ft supplemental towers are still operating. Lastly, a NEXRAD radar system, and The Weather Channel (TWC) are available to each of the control rooms and emergency response facilities.

The data acquisition program at the ORNL consists of three (two 100-ft and one 328-ft) meteorological towers. Meteorological data is fed to an ORNL central computer system for analysis and dissemination.

Research

NOAA Air Resources Laboratory/Atmospheric Turbulence and Diffusion Division (ARL/ATDD) is located in Oak Ridge near the ORR. The primary mission of ATDD is atmospheric research. Substantial research programs at ATDD are undertaken with the assistance of staff from ORISE/Oak Ridge Associated Universities (ORAU) and scientists from other national laboratories and organizations in the United States and abroad. ARL/ATDD also works closely with the ORAU to enhance educational opportunities in atmospheric science.

ARL/ATDD research attention is focused on the physics of the lower atmosphere, with special emphasis on the processes contributing to atmospheric transport, dispersion, and air-surface exchange, and on the development and improvement of predictive capabilities using the results of this research. Many other projects are underway such as surface energy balance and CO2 exchange studies and long-term studies of CO2 exchange aimed at process-level understanding.

Operationally, ARL/ATDD personnel provide meteorological consultation and supplemental data for air quality analyses, environmental reports, and hazard assessments and consequence assessments. Local climatology data are routinely collected and distributed. Under NOAA funding, ARL/ATDD operates a regional network of 15 towers ranging from the Cumberland Mountains (middle Tennessee) to the Smoky Mountains on Tennessee's eastern border. Wind, temperature, and precipitation data are recovered every 15 minutes by telemetry and made available to users.

ARL/ATDD incorporates NWS forecast products into the high-resolution, regional, meteorological model (i.e., RAMS) to produce twice daily 12-hour, 24-hour, and 36-hour predictions of surface winds for eastern Tennessee, and transport trajectory predictions for the ORR.

PACIFIC NORTHWEST NATIONAL LABORATORY (PNNL) / HANFORD SITE

Operational

The mission of Pacific Northwest National Laboratory (PNNL) is to deliver breakthrough science and technology to meet key national needs. PNNL is operated for the DOE by Battelle Memorial Institute. In support of its mission, the PNNL Fundamental Science Directorate (http://www.pnl.gov/fsd/) operates a diverse atmospheric sciences research program and provides meteorological support services to the Hanford Site through the Meteorological and Climatological Services Project (MCSP).

The Hanford Site has played a pivotal role in the nations defense for more than 40 years, beginning in the 1940's with the Manhattan Project. A plutonium production complex with nine nuclear reactors and associated fuel fabrication and material processing facilities, Hanford is currently engaged in the world largest environmental clean-up project. The Hanford Site occupies 586 square miles in a semiarid region along the Columbia River in southeastern Washington State.

The MCSP operates a meteorological monitoring network on and around the Hanford Site that consists of an array of 26, 33-ft towers, three, 200-ft towers and one, 410-ft tower instrumented with temperature, wind direction, wind speed, and other meteorological sensors. Meteorological data from this network is transmitted via Ultra High Frequency (UHF) radio to the Hanford Meteorology Station, where the data are processed, plotted for immediate display and use by station personnel, and copied to several file servers to provide data for emergency response and research applications. In addition to this extensive data acquisition program, the MCSP provides weather observation, analysis, and forecasting services 21 hours per day, Monday through Friday, and eight hours per day on weekends and holidays. The MCSP also generates monthly and annual climatology data summaries and provides input for annual site environmental reports.

Independent of the MCSP, the PNNL atmospheric science staff members operate meteorological and atmospheric dispersion workstations at the Hanford Site Emergency Operations Center (EOC). Atmospheric sciences personnel are involved in exercise planning, exercise control, and staff training activities for Hanford's emergency preparedness and response program. Assistance is also provided to state and county emergency operations facilities. PNNL staff members have developed MetView software that is used to graphically display Hanford Site and regional meteorological data to support a variety of emergency preparedness and research applications. Staff members have also developed Air Pollutant Graphical Environmental

Modeling System (APGEMS) software that realistically and rapidly models atmospheric dispersion and human health/environmental consequences that may be associated with a contaminant release on or near the Hanford Site. The easy-to-use interface and graphical output capabilities of APGEMS allow it to efficiently support a range of users including first responders, experienced hazard assessors, and decision makers.

Research

The Atmospheric Science and Global Change Division within the PNNL Fundamental Science Directorate (http://www.pnl.gov/atmospheric/) provides scientific leadership, intellectual knowledge, and advanced research capability in areas related to energy production and use, environmental stewardship, homeland security, and science and technology policy. A key element of this work involves research to understand and mitigate the effects of the production and use of energy on the atmospheric environment. The Laboratory's capabilities include investigator-initiated research, multi-institutional collaborative research, unique scientific instrumentation, and national thought and program leadership.

Fundamental investigations are undertaken that integrate theoretical studies with both large and small scale experiments and advanced modeling techniques to enhance our understanding of atmospheric chemistry and meteorology, transport and dispersion phenomena, and climate physics. Design and development of innovative scientific measurement equipment to advance fundamental understanding of atmospheric phenomena, from particles to clouds, is an important element to the Laboratory's work.

PNNL plays both management and developmental roles in the DOE Atmospheric Radiation Measurements (ARM) program (http://www.arm.gov/). The ARM program is focused on the development of cloud and radiation databases and data products that are critical to improved understanding of global and regional climate change and the improvement of climate research and prediction models.

PNNL conducts research into the processes affecting radiation transfer through the atmosphere and the effects of greenhouse gases, aerosols, and clouds on regional and global climate. The PNNL Atmospheric Remote Sensing Laboratory (ARSL) is a portable system for studying the vertical structure of atmospheric constituents, particularly clouds, which govern radiation transfer through the atmosphere. Capabilities of the Environmental and Molecular Sciences Laboratory (EMSL) are used to examine the structures and dynamics of molecular species important in contaminant chemistry, photochemistry, and atmospheric processes, including molecular level research into aerosol formulation and aging. Carbon dioxide emissions research is aimed at providing a scientific basis for forecasting future emissions of carbon dioxide and other gases of radiative importance.

PNNL provides leading integrated assessment modeling capabilities for linking climate science and carbon cycle behavior to human activities and ecosystems. Advancing the state of the art of this modeling framework and related tools, and delivering policy analysis and related research products for understanding and evaluating the impacts of global environmental change is another major focus of the work of PNNL.

In support of the DOE Atmospheric Science Program (ASP), ground-based and airborne measurements systems, numerical and conceptual modeling, and data analysis are used to conduct research into the vertical transport and mixing processes that govern the distribution in the lower troposphere of trace gases and aerosols released during energy production or use and on chemical processes that govern the transformation and fate of gaseous and particulate pollutants. PNNL manages the DOE Research Aircraft Facility, a Gulfstream 159 twin turboprop aircraft, that supports research in atmospheric chemistry, radiation transfer, and aerosol characteristics for DOE.

A hierarchy of atmospheric dispersion models is being developed within the Chemical Biological National Security Program (CBNP) of DOE covering transport distances ranging from around individual buildings, through the urban area and beyond the urban area into the surrounding region. These models will allow individuals in intelligence, law enforcement and emergency management to adequately plan against, train for and respond to potential terrorist attacks. PNNL scientists, in collaboration with other government and private scientists, are conducting atmospheric tracer and meteorological field studies for evaluating the models being developed within CBNP. The field studies will provide valuable information to all investigating urban dispersion, urban air quality and atmospheric transport and dispersion in general.

PANTEX PLANT

Operational

The Pantex Plant covers 15,977 acres and is located 17 miles northeast of Amarillo, TX, in Carson County. The Plant was a World War II munitions factory and was converted to a nuclear weapons assembly facility in 1951. Today, it is the nation's only assembly/disassembly facility supporting the nuclear weapons arsenal. The Pantex Plant is a government-owned, contractor-operated facility. NNSA oversees the operation of the Pantex Plant through the Amarillo Site Office, which reports to the Albuquerque Operations Office. Mason and Hanger

Corporation had been the operating contractor since 1956. On February 1, 2001, BWXT Pantex assumed the Pantex contract.

The Plant is composed of several functional areas, commonly referred to as numbered zones. These include a weapons assembly/disassembly area, a weapons staging area, an area for development of experimental explosives, a drinking water treatment facility, a sanitary wastewater treatment facility, and vehicle maintenance and administrative areas. Other functional areas include a utility area for steam and compressed air, an explosive test-firing facility, a burning ground for thermally treating explosive materials, and landfills. Overall, there are more than 700 buildings at the Pantex Plant.

The Pantex Plant maintains a meteorological monitoring station located on the northeast corner of the site. The monitoring station is an instrumented 197-ft tower that was erected approximately 2.3 miles north of the Zone 12 production area in the late 1970s to support the gathering of meteorological data for construction of a commercially owned and operated power plant in the Texas Panhandle near Amarillo. The project was abandoned in the early 1980s and the tower was left in place and turned over to Pantex Plant management.

The Environmental Protection/ Restoration Department (EP/RD) of the Environment, Safety and Health Directorate is tasked with the implementation of the quality assurance program for the meteorological data captured by the onsite two-level meteorological tower. The data from this tower, monitored at the 33-ft and 197-ft elevations are collected and used by the DOE National Atmospheric Release Advisory Center (NARAC) site workstation, located in the Plant EOC. These data are collected and archived as 15-minute averages plus maximum and minimum values for each 15-minute period. They are primarily used for input to the NARAC emergency response models that could be used for consequence assessment purposes for off-normal events involving radionuclides. Annual dispersion model calculations of offsite radiation doses from routine emissions of onsite sources, required by 40 CFR 61, Subpart H, *National Emission Standards for Hazardous Air Pollutants (NESHAP)*, are accomplished by the EP/RD. EP/RD uses the EPA-approved CAP88-PC atmospheric transport and dispersion model and the Pantex meteorological tower data processed into the STAR format. This department also maintains the Pantex Plant climatology database.

The tower is equipped with two sets of sensors, located at the 33-ft and 197-ft levels. Wind speed, wind direction, and temperature sensors are located at both levels, with a dew point sensor located at the 33-ft level. A barometric pressure sensor is located on the tower approximately 6 ft above the tower base. A solar insolation pyranometer and a tipping bucket rain gauge are located adjacent to the tower at approximately 3.3 ft above ground level. In 1992, a photovoltaic panel was added to provide backup power for the main 110-volt AC power/battery system. The system is more fully described in a 1993 report prepared by PNNL (Snyder, 1993a).

Meteorological tower data is also used by the Authorization Basis (AB) and Nuclear Explosives Safety Departments for plume transport and dispersion modeling applied to the Plutonium Dispersal Consequence Analysis for the Safety Analysis (SAR) and Basis for Interim Operations (BIO) validation and upgrade reports, other operations directives, and other safety analyses.

Routine preventive maintenance on the meteorological instruments as well as calibration and certification was performed semi-annually by the United States Bureau of Land Management (BLM) until the contract ended. The older meteorological sensors and associated equipment that were installed and maintained by the BLM will be replaced with equipment selected by personnel from NARAC. Annual meteorological data are used in the U.S. Environmental Protection Agency (EPA) atmospheric dispersion model CAP88-PC to assess the radiological dose to the public from potential radiological releases at Pantex Plant, as required under 40 CFR 61.92. Through 1992, the data employed in all atmospheric dispersion modeling were National Oceanic and Atmospheric Administration (NOAA) meteorological data collected at the Amarillo International Airport, about 10 miles southwest of Pantex Plant. Beginning in 1993, meteorological data collected from the Pantex Plant meteorological tower were employed in atmospheric dispersion calculations and for other activities requiring meteorological data, such as preparation of the annual Site Environmental Report (ASER) for the Pantex Plant.

Temperature differences between the two tower levels are examined on almost a daily basis by operators of the Plant Burning Ground. Operation of

the Burning Ground is limited under the terms of the Plant Hazardous Waste Permit to times when no low-level temperature inversion is present. Burning Ground operations are also restricted to low wind-speed conditions. Plant meteorological data are also employed in short-term (i.e., puff) and long-term (i.e., plume) atmospheric dispersion calculations for emergency response to accidental radiological releases to the atmosphere, through NARAC. Other onsite users of Pantex Plant meteorological data include the building freeze-protection program, which is designed to alert building managers and the Utilities Department to the possibility of freezing pipes during winter months; the Pantex Plant Fire Department, which obtains wind direction and wind speed information before responding to alarms; the Texas Tech Research Farms, which use the data in crop-spraying operations; and Plant Security, which uses the data to control operations at the pistol and rifle ranges. Other onsite users include construction contractors, who use the data to validate adverse weather-caused work stoppages; explosive test-fire facilities, which use the data to limit downwind noise nuisances; and the emergency spill response teams, who use the data to predict plume movement. The data are also being used in support of routine air monitoring, present and future Plant operations, air permit submissions to the State of Texas, and state agencies doing environmental work in the area under the Agreement in Principle between DOE and the State of Texas.

In 2005, the sensors and most of the other components of the Pantex Weather tower will be replaced with Campbell Scientific equipment. New vendors are being evaluated to take over the maintenance and calibration work.

Research

There is no current or projected meteorological research activities planned at the Pantex Plant.

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE (RFETS)

Operational

The RFETS is managed by the Rocky Flats Office (RFO) and is located approximately 16 miles northwest of downtown Denver, CO. One of the smaller DOE sites, the facility occupies a 10 square mile area along the foothills of the Rocky Mountain Front Range. This site has been decommissioned and after verification of closure criteria by DOE, the entire reservation will be transferred to the Department of Interior (DOI).

A 200-ft meteorological tower at the west-end of the site continuously monitors meteorological conditions at surface, 33-ft, 82-ft, and 197-ft above ground level. The data are analyzed, quality assured, and assembled into data sets for use in atmospheric modeling, climatology, and other analyses at the site. Data from the 200-ft and 33-ft towers are also transmitted back to the main site every 15 minutes by telemetry for use in emergency response modeling. The Regional Atmospheric Response Center (RARC) conducts meteorological activities associated with emergency preparedness and response at the site. An upper air remote sensing Sound Detection and Ranging/Radio Acoustic Sounding System (SODAR/RASS) continuously monitors winds, temperatures, and atmospheric stability above the RFETS site.

Through a cooperative agreement with the Colorado Department of Public Health and Environment (CDPHE), meteorological data are transmitted to the site from five surface meteorological stations by telemetry that form a ring around the site perimeter. Another cooperative agreement with NOAA provides near real-time data from multiple monitoring sites throughout the Denver metropolitan area. These data are all received, quality assured, and combined into a three-dimensional observation set for emergency response modeling every 15 minutes, 24 hours per day.

The RARC provides 24-hour consequence assessment support for any unplanned radiological or chemical releases from the site. The Center responds with customized weather forecasts, plume projections, and dose modeling results that lead to event classifications and protective actions for on-site and off-site populations. RARC also conducts specialized consequence assessments in support of emergency preparedness, hazard assessments, and risk assessments for RFETS. Weather forecasts are provided for severe weather events, such as winter storms, windstorms, and severe thunderstorms.

A customized modeling system has been developed and implemented at RFETS to predict the pathway and impacts from any radiological emergency at the site. Called the Computer-Assisted Protective Action Recommendation System (CAPARS), the new capability addresses the need for fast, accurate plume predictions in a complex atmosphere.

CAPARS provides a variety of plume, weather, hazard, and related products with the accuracy and speed needed for response to an emergency at RFETS. Eleven integrated major subsystems form the overall CAPARS capability.

The State of Colorado has formally accepted the CAPARS modeling system for emergency response and planning applications at RFETS. A specialized planning version of the CAPARS system has been developed, implemented, and applied for emergency planning at the RFETS. Called the TRAC Risk Assessment/Hazards Assessment Model, the capability is

designed to support hazards and risk assessments for RFETS and to form the basis for an evaluation of the size and shape of the Emergency Planning Zone (EPZ) surrounding RFETS.

Research

There is no current or projected meteorological research activities planned at RFETS.

SANDIA NATIONAL LABORATORY (SNL) - ALBUQUERQUE

Operational

The DOE Site Office manages SNL in Albuquerque, NM, located between the Rio Grande Valley and Manzano Mountains. SNL covers approximately 80 square miles of flat to mountainous arid terrain. Meteorological Programs at SNL include both operational support and research activities.

Meteorological services and support are provided through the EOC in the Laboratory Services Division (LSD). The mission is to provide meteorological support for various operations including:

- Emergency response;
- Environmental surveillance and characterization; and,
- Regulatory compliance.

The monitoring network consists of six, 33-ft and two, 197-ft towers used to measure wind direction and speed, ambient temperature, and relative humidity. There are also three precipitation gauges, two barometric pressure sensors, and one solar radiation pyranometer in the network.

Research

Key research activities are provided through the Energy and Critical Infrastructure Center in the Energy, Information, and Technology Division. SNL scientists are involved in the ARM program and the Surface Heat Budget of the Arctic Ocean (SHEBA). The ARM project is a combined measurement and modeling program. The goal is to gain a better understanding of clouds and their effect on atmospheric radiation, with the final goal of developing better climate models. The SHEBA program addresses the interaction of the surface energy balance, atmospheric radiation and clouds over the Arctic Ocean.

SAVANNAH RIVER SITE (SRS)

Operational

The SRS is under the responsibility of the Savannah River Operations Office (SROO) and operated by the Washington Savannah River Company (WSRC). SRS is located in southwestern South Carolina, along the banks of the Savannah River. The SRS covers an area of approximately 300 square miles and is thickly forested with pine trees. There are also several small streams, a large swamp, and two reservoirs built as cooling ponds for nuclear plant reactors. The topography of SRS is characterized by gently rolling hills with an adjacent flood plain near the Savannah River. The climate at SRS is typical of the southeastern United States with long, hot and humid summers and short, mild winters.

The Atmospheric Technologies Group (ATG) of the Savannah River National Laboratory (SRNL) has developed and operated a meteorological monitoring and modeling program at the SRS since the early 1970's. This program supports SRS operations in emergency response consequence assessment, weather forecasting, radiological and non-radiological air quality calculations for regulatory compliance, safety analyses, environmental impacts, engineering studies, environmental sciences research and non-proliferation activities.

The ATG meteorological data sources are extensive and quite varied. Onsite meteorological data are obtained from a network of either 200-ft meteorological observing towers located near the major production sites. The instrumentation on those towers includes sensitive bi-directional vanes (i.e., bivanes), cup anemometers, resistance thermometers and lithium chloride humidity sensors. Another tower is located at the Central Climatology facility, located near the geometric center of the SRS. It includes like instruments near ground level, 60-ft, 120-ft, and 200-ft. Additional meteorological instruments at the Central Climatology facility include precipitation, evaporation, barometric pressure, soil temperature, solar and long wave radiation. Data are collected with dedicated data loggers at each tower site. Each logger is then polled by a remote computer that, in turn, populates a relational database with meteorological data.

A network of twelve manually-read rain gauges is located throughout the SRS. Additional local upper-air data are collected for special cases from a balloon-launched airsonde system and a portable tethersonde system. Portable towers are available for special studies.

ATG also has access via satellite to real-time regional, national, and international meteorological data from a commercial weather data provider. The data include surface observations, satellite and radar imagery, and predictive model information from the US and abroad.

In addition, ATG has developed the Weather INformation and Display (WIND) System as an automated resource for conducting real-time consequence assessments following unplanned releases of hazardous material. The WIND System is a multi-computer platform network that links the real time meteorological observations and forecasts with a suite of

atmospheric and aqueous transport and dispersion models. A rolling 24-hour data file is created from data archived in the meteorological database and disseminated to a pc-based workstation that can operate the WIND System modeling and display software.

In the mid 1990's, a mutual aid agreement with surrounding counties emergency management agencies was created to install and operate four meteorological towers at nearby chemical plants in support of emergency response activities. Data from these towers are incorporated into the SRS meteorological database, integrated into the 24-hour data file, and made available beyond the SRS firewall for use by the off-site partners using appropriate WIND System software.

Two television stations, WJBF and WAGT, have built a new television tower near SRS, where SRNL has installed meteorological instrumentation at 100-ft, 200-ft, and 1000-ft. This local television transmitter tower was instrumented with fast response three-dimensional sonic anemometers and optical water vapor and CO2 sensors at each of the three levels along with slow-response temperature and humidity sensors at 200-ft and 1000-ft. The data from this tower is used for both operational emergency response and for USFS controlled burns. The data is also used for research projects in the atmospheric boundary layer.

A joint partnership between Westinghouse Electric Company and a local television station provides real-time local Doppler radar data to SRS and the local community. The data (e.g., static and time lapse - movie- images) are available through the site internal computer network at employees' desktop computer for assistance in site operations.

ATG utilizes a regional mesoscale model, RAMS, for detailed 24-hour forecasts which are input to the predictive component of the WIND System models. Transport calculations blend observed meteorological data with RAMS forecasts to make timely and accurate assessments. The grid resolution used in RAMS varies from 2 km for the inner grid (i.e., 100 km x 100 km centered on the SRS) to 8 km for the outer grid (i.e., 250 km x 250 km).

The SRNL Atmospheric Technology Center supplies local, national, and international meteorological data to support SRS and Weather Field Office (WFO) customers and daily weather forecasts to support site operations. Typical customers include waste handling groups where wind and rain forecasts often determine daily activities. Also, ATG supports the United States Forest Service (USFS) prescribed burn program and site heat stress program with detailed observations and forecasts. Custom forecasts are also provided to facility and other senior managers to support protective action decisions for severe weather.

Research

SRS meteorological data are used to validate and improve operational RAMS mesoscale model forecasts and to support environmental and engineering studies.

WASTE ISOLATION PILOT PLANT (WIPP)

Operational

The Waste Isolation Pilot Plant (WIPP) is operated by Westinghouse TRU Solutions (WTS) for the DOE Carlsbad Field Office (CBFO). A cornerstone of the DOE national clean-up strategy, the WIPP is designed to permanently dispose of transuranic (TRU) radioactive waste generated by defense-related activities in the Salado salt formation 2,150 feet beneath the surface. WIPP is located in Eddy County in southeastern New Mexico, 32 miles east southeast of Carlsbad, NM, and occupies 16 square miles of a region know as Los Medanos. Geographically, the region is regarded as a relatively flat, sparsely inhabited plateau with little surface water.

The WIPP Environmental Monitoring and Hydrology (EM & H) Section performs meteorological monitoring as part of the Non-radiological Environmental Monitoring Program (NEMP). The meteorological station provides measurement of wind direction and wind speed, and temperature at 6-ft, 33-ft, and 164-ft, as well as ground level measurements of barometric pressure, relative humidity, precipitation, and solar radiation. The main function of the meteorological station is to generate data for operational support, emergency response and regulatory atmospheric transport and dispersion modeling applications. Parameters are monitored continuously and the data are stored in the Central Monitoring System (CMS), a computerized system including automated parameter checks, real- time displays in the Central Monitoring Room (CMR), and data archiving. Meteorological data are compiled and distributed to stakeholders, including the NOAA NWS at Midland-Odessa, TX, on a monthly basis.

WIPP also, under a cooperative agreement with the NWS, maintains a Cooperative Weather Observing Station nearby the primary meteorological tower. Data from this station are compiled monthly and the Record of Climatological Observations form is submitted to the Weather Forecast Office in Midland-Odessa, TX. Under the same cooperative agreement, the Midland-Odessa office is given access to real-time data from the primary meteorological station.

Research

There is no current or projected meteorological research activities planned at WIPP.

YUCCA MOUNTAIN PROJECT (YMP)

Operational

As part of the DOE Office of Civilian Radioactive Waste Management (OCRWM), the Yucca Mountain Project (YMP) studies may eventually support a recommendation of Yucca Mountain for the nation's first geologic repository for spent nuclear fuel and other high level radioactive waste. The current meteorological program within the YMP focuses on environmental compliance and operational health and safety considerations, for both employees and the general public.

As with a number of DOE sites, the Yucca Mountain area is one of complex topography and heterogeneous surface characteristics, creating mesoscale conditions that locally influence onsite weather. The YMP meteorological program, therefore, includes four full stations for measuring atmospheric dispersion and general meteorological conditions, as well as nine precipitation stations. These stations serve to monitor the significant variations in airflow, rainfall, and temperature caused by the area's complex terrain environment. The meteorological stations are key to the thorough monitoring of these variations that is essential for the YMP ongoing commitment to environmental compliance and to the health and safety of employees and the public.

The YMP meteorological program also provides essential data for the studies necessary to evaluate the site's suitability for a potential repository. Should the site be deemed suitable and a repository licensed, built, and operated, water would be the primary means by which radioactive materials could be transported to the accessible environment. Thus, movement of water from the atmosphere to the surface and on through the mountain is a key concern. The meteorological program provides essential data for the infiltration model of the mountain. Data about precipitation, humidity, evapotranspiration, surface water run-on, solar radiation, air temperatures, and wind patterns all contribute to the overall infiltration model. The model gives special emphasis to the transient, or temporal, versus steady-state rates of water movement through the unsaturated zone of rock at Yucca Mountain. The temporal variation of infiltration may be short term, due to weather fluctuations that drive episodic flow, or much longer term, in periods corresponding to climate change. Data from the meteorological program's ongoing monitoring programs are supplemented by the program's paleoclimatology studies. Together, they provide essential information for the YMP modeling of past, present, and future infiltration rates.

If the potential repository were actually built and operated, continuous meteorological monitoring and analysis would also be essential for the operational facilities on the surface of the mountain, at least until the final closure of the repository. Buildings would be built to withstand the probable maximum flood and wind conditions, and administrative controls would be in place to suspend operations during severe weather conditions. An integral part of the emergency response system would include monitoring the overall environmental situation at the repository site.

In turn, an integral part of the overall environmental monitoring system would be the meteorological monitoring system. This system would collect real-time meteorological information about the site and provide weather forecasting and climatology data. Such data would be essential for management decisions regarding the health and safety conditions for employees and the public.

Research

There is no current or projected meteorological research activities planned at the Yucca Mountain site.

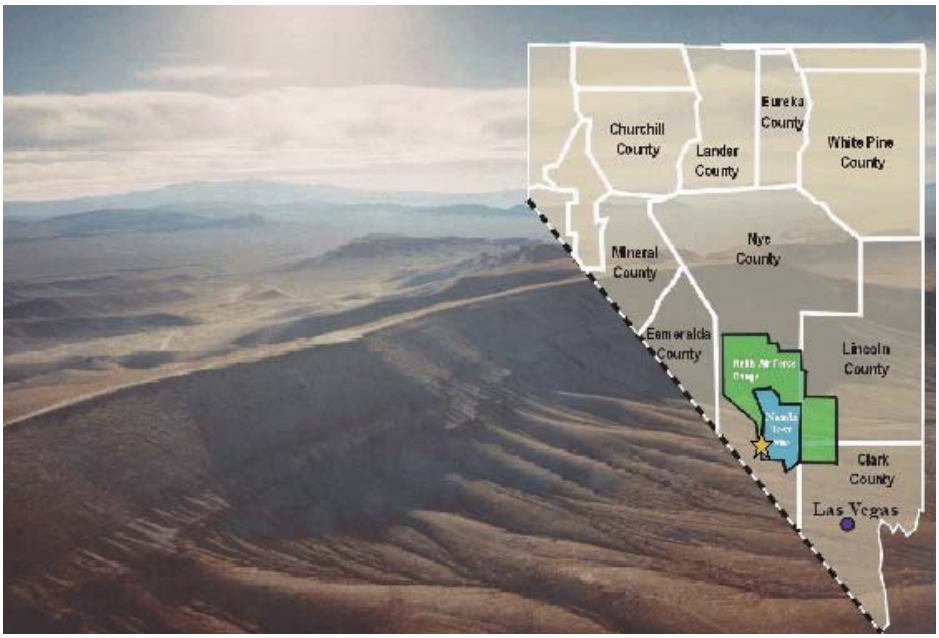


Figure 3-DOE-5. Yucca Mountain (100 miles northwest of Las Vegas, Nevada) is unpopulated land owned by the Federal Government and adjacent to the nation's nuclear weapons test site.