Weather INformation and Display (WIND) System

Savannah River National Laboratory's Atmospheric Technologies Group

The Savannah River National Laboratory's Atmospheric Technologies Group (ATG) Weather INformation and Display (WIND) System is a computer-based resource for predicting the consequences of an accidental release of hazardous materials to the environment. To achieve timely and reliable operations during emergency response, ATG designed the WIND System to integrate all essential elements into a single, automated process. A central WIND System computer cluster continuously collects and archives high quality meteorological observations from a network of regional monitoring sites using cost-effective communications links. In addition, the WIND System computers have access to detailed regional forecasts generated routinely by the ATG using an advanced atmospheric model. In the event of an unplanned release, a comprehensive suite of computer models are configured to retrieve these observations and forecasts and perform rapid predictions of the transport of the release through the environment.

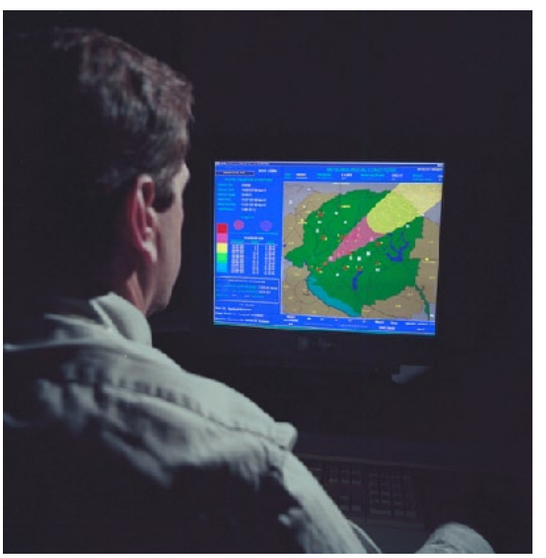

Figure 1. WIND System displays of hazardous material releases provide vital information for emergency response.

For over 25 years, the WIND System has proven to be a valuable emergency response asset for the Savannah River Site (SRS) and local communities throughout the region. Moreover, the resources can now be applied to support emergency response needs throughtout the Southeast. The ability of the WIND system to deliver timely and reliable results directly to the local decision-maker is crucial for ensuring adequate protection of public health and safety.

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Basic WIND System Configuration

The backbone of the WIND System is a cluster of UNIX workstations located in the SRS central computer facility. This workstation cluster gathers data from a network of meteorological monitoring stations and archives these data in a relational database. Every 15 minutes, the observations are extracted from the database and downloaded, along with current forecasts from ATG's operational atmospheric modeling, to desktop PCs. Consequence assessment models residing on the PCs can then be run with the current observations and forecasts to generate real-time predictions of downwind hazards. To ensure high system reliability, the UNIX cluster has been configured for redundant operations, i.e., if one computer fails, WIND System functions can be performed by other machines in the cluster. In addition, all hardware in the cluster is configured for uninterrupted power.

Environmental Data Sources

Meteorological Measurements. An essential component of the WIND System is the ATG's world-class meteorological monitoring program. Towers located adjacent to each of the SRS's eight major operations areas are instrumented for accurate measurements of wind direction, speed, turbulence, temperature and dew point. Measurements are taken at an elevation of 200 feet above ground to provide adequate characterization of conditions above the surrounding forests. Data are also collected from ATG's Central Climatology facility located near the center of SRS. Central Climatology is instrumented with wind and temperature sensors at four levels through 200 feet, as well as ground-level instrumentation to measure precipitation, solar radiation, barometric pressure. The ATG also operates instrumentation on a TV tower facility located near the SRS which provides high quality measurements of wind,

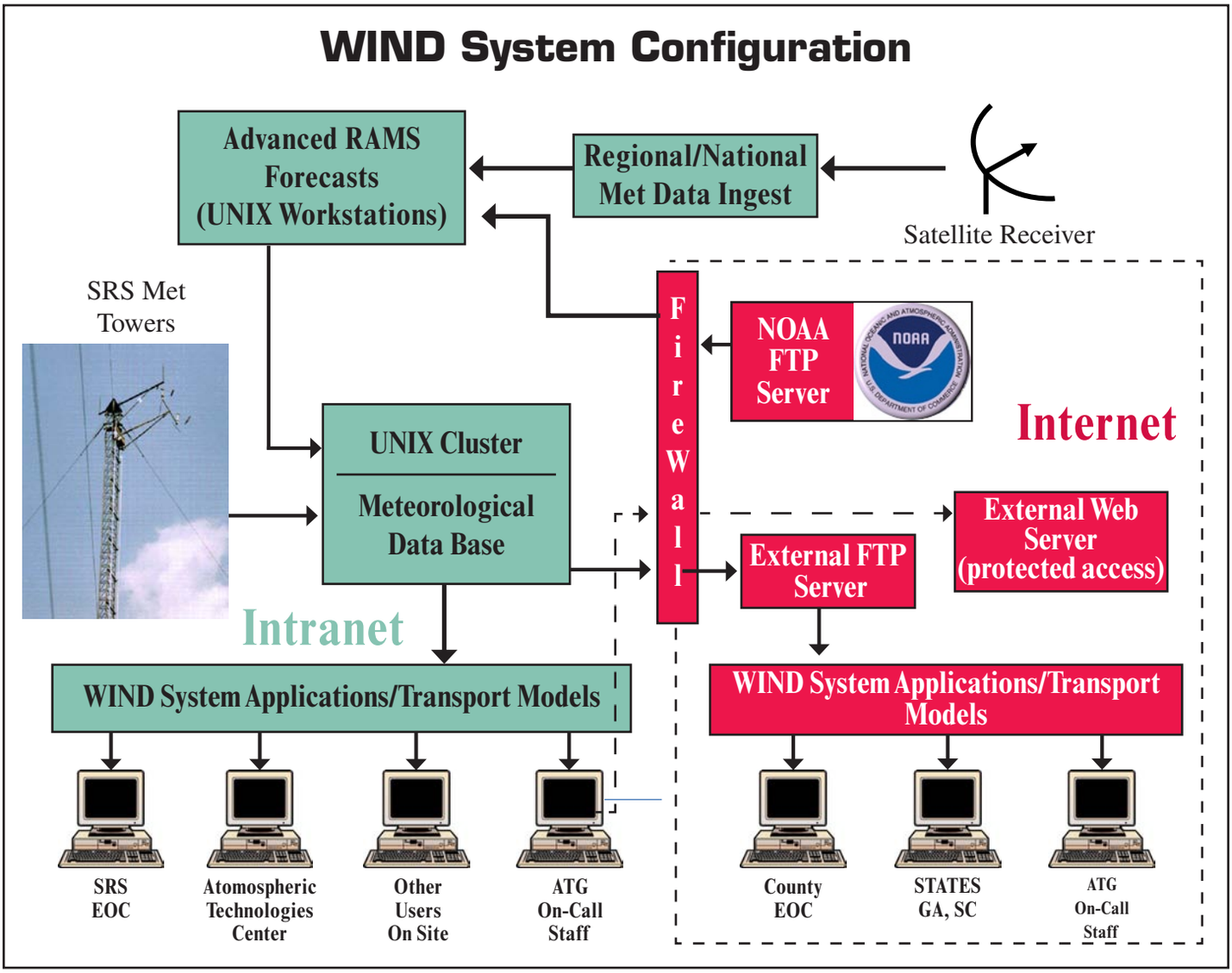

Figure 2. WIND System Information Flow.

temperature, and moisture at several levels through 1000 ft. Observations recorded by data collection units at each of these monitoring sites are transmitted to the primary WIND System computers every 15 minutes and stored in a relational database.

Several design features enhance the reliability of data acquisition: (1) data transmission over dedicated, conditioned telephone lines (onsite towers), or radio frequency broadcast (TV tower); (2) sophisticated grounding systems and electronic circuitry to protect the equipment from lightning; and (3) local data loggers capable of remote storage of several days of 15-minute data, which can later be queried to backfill the real-time database. On-line software performs quality control checks to ensure erroneous data are not inadvertently used in the transport model predictions.

The WIND System has proven to be a timely, highly reliable resource for emergency response, providing a source of information essential for ensuring adequate protection of public health and safety.

In 1996, mutual aid agreements with five counties surrounding the SRS led to the installation of additional meteorological monitoring stations in four industrial areas of Augusta/Richmond Co. (GA). Wind, temperature, and humidity data are collected and archived by the WIND System computers through a process identical to that used for the SRS towers. In turn, real-time data from all of the WIND System monitoring sites are made available to emergency managers in each of the five counties through automated download protocols.

Measurements from the regional monitoring network are supplemented by Southeastern U.S. surface observations and upper-air soundings from the National Weather Service (NWS). The NWS information is available to the WIND System in real-time via satellite transmission through a private sector meteorological service.

Meteorological Forecasts. The ATG has developed an operational configuration for the Regional Atmospheric Modeling System (RAMS) to produce near real-time predictions of complex three-dimensional atmospheric motion throughout the Central Savannah River area and much of the Southeast U.S. Detailed eight-hour forecasts of wind speed, direction, turbulence and other meteorological variables are generated every three hours for a region encompassing the Central Savannah River area; 24-hour forecasts are generated for an area that includes much of Georgia and South Carolina are produced every 12 hours.

WIND System consequence assessment models utilize a blend of observations from the monitoring tower network and RAMS forecasts to produce projections of potential downwind hazards that are much more reliable than projections based on simple persistence of a current observation.

Transport/Consequence Assessment Modeling

A suite of environmental transport models is available to support consequence assessments and protective action decisions during all phases of emergency response. These models have a documented record of performance through

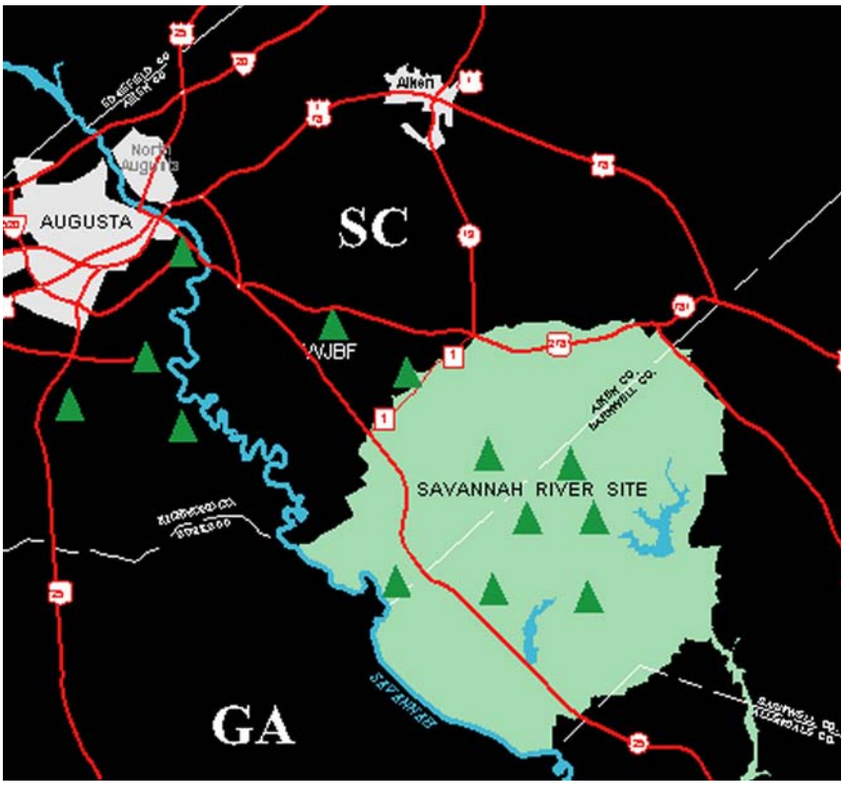

Figure 3. The WIND System at SRS is linked to an extensive array of meteorological monitors.

computer code verification and comparisons with field data collected during tracer gas studies.

The ***Area Evacuation Program*** is a straight-line Gaussian plume dispersion model that provides nearly instantaneous results to operators responsible for protecting workers in or near the incident area. Area Evacuation automatically accesses data from the nearest meteorological tower, calculates downwind chemical concentrations or dose rates, and graphically displays the results on a base map of the incident area.

The ***Puff/Plume Program*** is a highly flexible trajectory Gaussian model that provides an initial, reasonably conservative estimate of downwind concentration/dose to the public. Release trajectories are constructed for up to 12 hours of observed and forecast winds. Users can select a contaminant from a list of 42 radioisotopes or 180 hazardous chemicals, then choose whether to model the release as a puff or plume, as a point, area, or volume source, or to include wet and dry deposition of contaminant on the ground. In addition, the program's graphical interface allows a flexible point-and-click definition of release location. Tabular and graphical output from the model, available in less than a minute, provides an estimate of the release's downwind arrival times, as well as concentration/dose and deposition along the cloud centerline. Output can also be exported for use with geographic information system software.

Detailed local and regional predictions of airborne transport are performed with the ***2DPUF Program***. ***2DPUF*** utilizes a sequential Gaussian puff model, providing more realistic representations of prolonged releases in winds that vary in time. For a regional calculation, 2DPUF wind fields are based on surface and upper air observations from National Weather Service observing stations throughout the Southeast U. S. Tabular and graphical output provide realistic estimates of radiological dose (inhalation and cloud shine). In addition, deposition estimates from 2DPUF are useful in assessing the indirect consequences of a release, such as ingestion of contaminated foods.

A ***Lagrangian Particle Dispersion Model (LPDM)*** can be applied for highly refined, transport and dispersion analyses on local to regional scales. The LPDM is capable of fully utilizing three-dimensional winds forecast by RAMS to account for complex wind patterns, such as sea breeze fronts penetrating inland over the South Carolina and Georgia midlands. A graphical interface allows users to specify up to five release locations at SRS or surrounding region. Radiological releases can include calculations for deposition. Output consists of graphical and animated displays of instantaneous concentration, integrated concentration, deposition, and radiological dose due to inhalation, cloud shine, or ground shine. Deposition output also indicates the areas in which ingestion pathway Derived Intervention Levels are exceeded.

The ***Stream Transport Program*** provides a unique capability for predicting the transport of aqueous releases into streams or rivers. Utilizing a two-dimensional hydrologic model, a release is assumed to travel through a series of predetermined stream segments. Flows for each segment, derived from historical U.S. Geological Survey stream gauge data, are accessed by the model to calculated transport times and concentration for critical downstream receptor locations, such as the intakes to public water supplies.

For more information on the WIND System, contact:

C. H. Hunter, Manager, Atmospheric Technologies Group
Phone: (803) 725-2953; E-Mail: chuck.hunter@srnl.doe.gov

R. P. Addis, Manager, Nonproliferation Technologies Section
Phone: (803) 725-3325; E-Mail: robert.addis@srnl.doe.gov

Major program areas of the Atmospheric Technologies Group are described in the following brochures:

- Advanced Atmospheric Modeling
- Atmospheric Technology Center
- Climatology
- Hydrology and Surface Water Modeling
- Meteorological Measurements
- Remote Sensing Application
- Tall Tower Meteorlogical Monitoring System
- The People of ATG

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