Meteorological Measurements

Savannah River National Laboratory's Atmospheric Technologies Group

The Savannah River National Laboratory's Atmospheric Technologies Group (ATG) of the Non-Proliferation Technologies Section (NTS) employs a nationally and internationally recognized team of highly trained meteorologists, engineers, computer scientists, and technicians. ATG's meteorological data is used for many purposes including real-time atmospheric modeling support for unplanned releases and the creation of long-term climatological data bases used for engineering, environmental, safety and air quality studies. Forecasts for heat stress conditions, for wind sensitive activities, and for potentially damaging freezing conditions are also supported by ATG's meteorological monitoring program.

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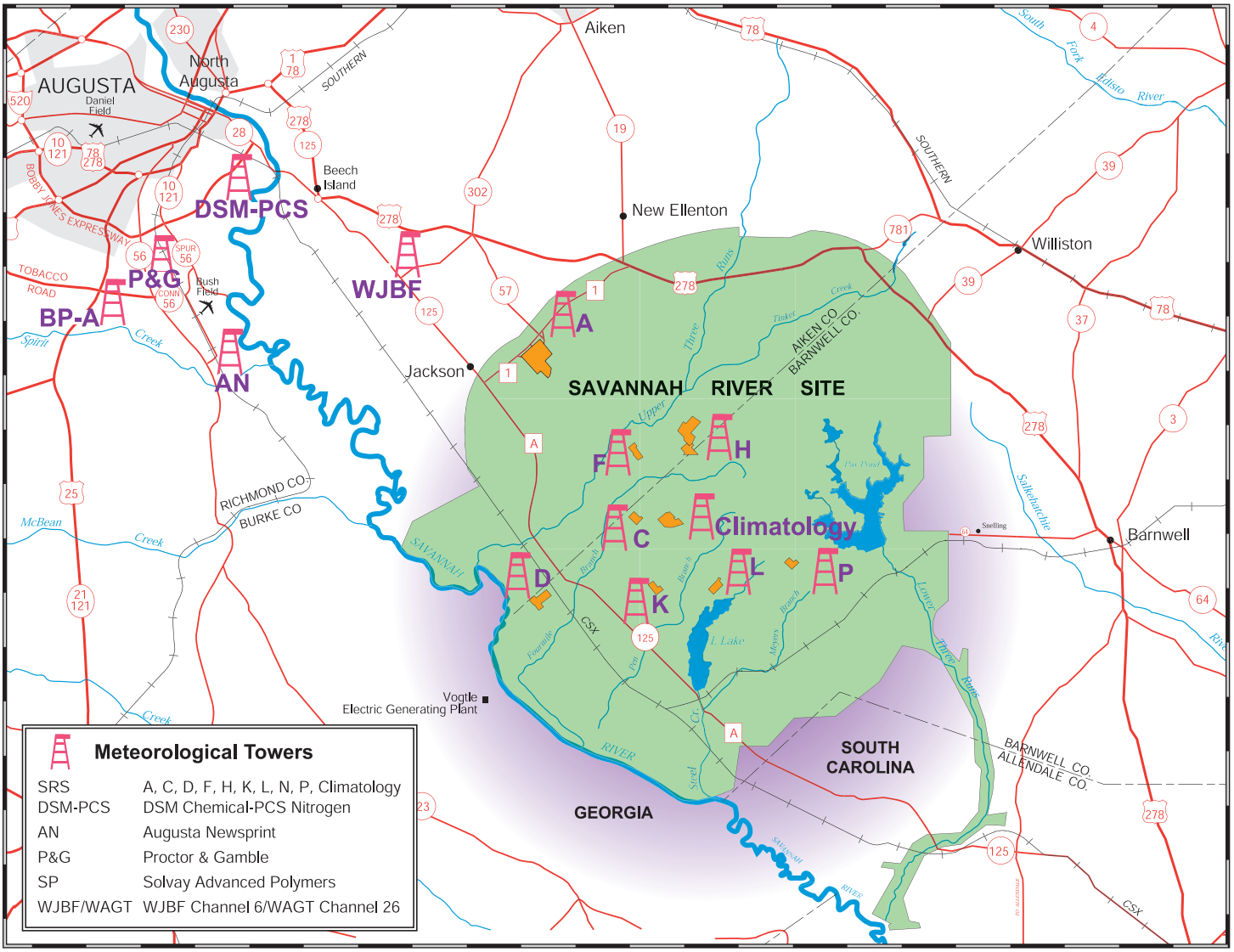

Figure 1. Tower locations

Meteorological Measurements (contd)

ATG developed and presently operates an automated network of meteorological observation towers that provide timely, accurate real-time meteorological data. ATG also creates customized systems to meet the specific requirements of onsite and offsite customers. Instruments are calibrated by ATG to DOE, ANSI, EPA, or ASTM standards with traceability to the National Institute of Standards and Testing (NIST).

ATG's meteorological observation towers (Figure 1) are located near all of the major SRS facilities (A, C, D, F, H, K, L, N, and P Areas). Under a 1996 Mutual Aid Agreement (MAA), four additional tower sites were created at hazardous materials corridors in Augusta/Richmond County, Georgia (Figure 2). The MAA was created to provide real-time meteorological monitoring and emergency modeling information in hazardous materials corridors beyond the boundary of the SRS. Measurements of wind speed, direction, turbulence, air temperature or dew point/relative humidity are made at 200 feet above ground on all of the site towers and at various heights above ground level on the offsite towers. An additional SRS tower, Central Climatology, is instrumented at multiple levels to obtain atmospheric profile data.

For continuous monitoring applications, ATG uses bi-directional wind vanes, or bivanes (Figure 3), to measure horizontal wind direction, vertical wind direction, and atmospheric turbulence. Cup anemometers are used to measure wind speed. Air temperature is measured with platinum resistance probes, dew point temperature with lithium chloride resistance sensors, and relative humidity with capacitive film circuits. All temperature and moisture measurements are made with aspirated solar radiation shields. For noncontinuous or special studies, ATG often uses various types of ultra-sonic (sonic) wind sensors, optical temperature sensors, and temperature thermocouples. Specialized monitoring platforms with self-contained data logging systems are also employed for field studies.

Special Equipment

ATG operates a wind tunnel (Figure 4) for sensor calibrations, testing, and research and development of meteorological sensors. The test section of the wind tunnel is approximately one meter by one meter by 2 meters. Flow rates within the test section can be adjusted between about 0.25 meter per second to about 23 meters per second. A portable data acquisition system is used to monitor

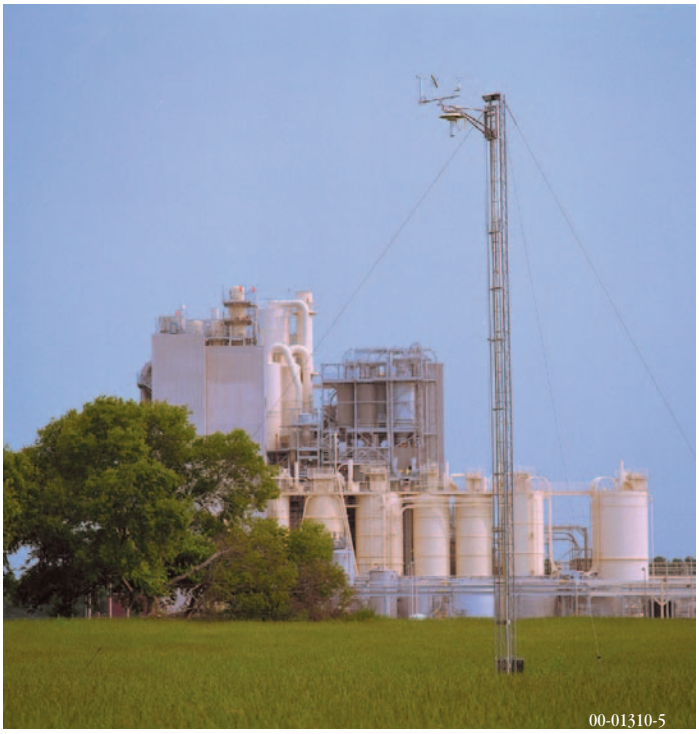

Figure 2. The meteorological tower at the Procter & Gamble Augusta plant

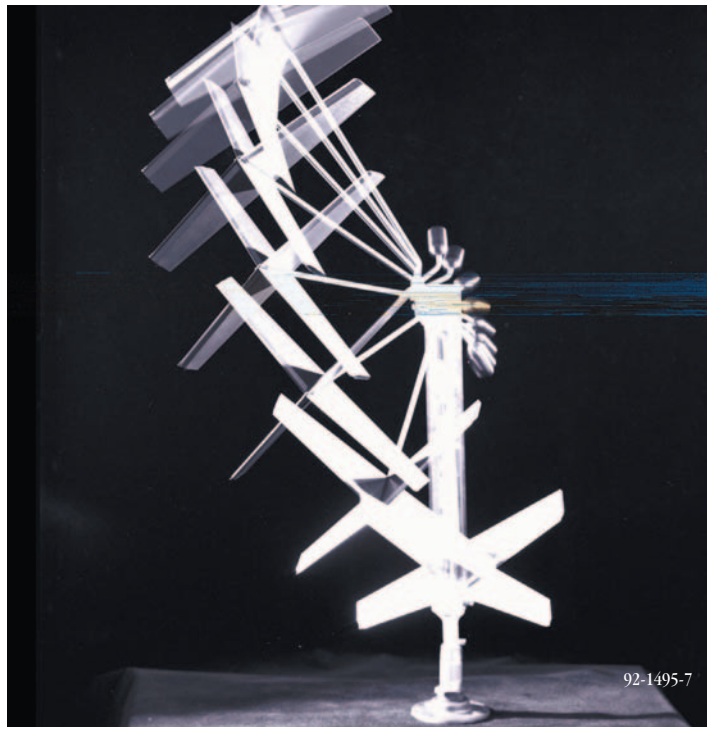

Figure 3. A multiple exposure photograph of a bi-directional wind vane or "bivane". The bivane measures the horizontal and vertical wind direction simultaneously.

and evaluate meteorological sensor performance. Independent wind tunnel tests of the ATG wind tunnel showed excellent performance accuracies to within 0.4%. The ATG wind tunnel has been successfully used in two Cooperative Research and Development Agreements (CRADA).

ATG also has the capability to measure upper level wind and temperature profiles through the use of weather balloons. Launches can be performed from the Meteorological Engineering Facility or from remote locations in the field.

Ongoing Projects

From the mid-1960s through the latter 1990s, ATG obtained in-situ measurements up to 1,000 feet from a nearby television tower. In 2004, this capability was restored under a project to create a new meteorological monitoring system on a brand new tower. The new meteorological monitoring system incorporates state-of-the-art three-dimensional sonic wind sensors, atmospheric flux measurements, and a modular design able to incorporate future additional sensors.

ATG has installed an electric field sensor in A Area. Measurements of the electric charge of the atmosphere are averaged each 15-minute period. These averages along with the extrema, both maxima and minima, are achieved. In the future, ATG plans to create a real-time electric field display system to monitor for thunderstorms that threaten the site.

An automated rain gauge system to replace the manually-read network is planned by ATG. Data would be transmitted every 15 minutes via radio-frequency transmission to a centrally located computer for dissemination and storage. Accurate tipping-bucket rain gauges would replace plastic rain gauges to ensure dependable remote operation.

Under the MAA, additional meteorological monitoring towers may be installed in participating counties surrounding the SRS. Possible locations in Columbia County, Georgia, include a tower near a large industrial complex and another near Interstate 20. Additional potential tower sites within Aiken County, South Carolina include North Augusta and downtown Aiken. Portable towers may also be added to the network.

Figure 4. ATG's wind tunnel in the Meteorological Engineering Facility

ATG and the Savannah River Forest Station (SRFS) joined forces to install a real-time soil moisture monitoring system within the forest canopy (Figure 5) and under a grassy, open area. It is likely that this system will be expanded to other sites and that the data will be correlated with radar, atmospheric boundary layer height, and remote-sensing data sets to create new predictive algorithms for soil moisture.

ATG has been heavily involved in conducting ground-truth measurements at several sites across the country for different government satellites. The capability to accurately monitor the fine-scale structure of surface water temperatures or man-made surfaces has been developed and will be deployed for several years to come.

In response to the need to monitor the condition of buried tower anchor rods, SRNL's Nondistructive Examinations Group and ATG jointly developed SoundAnchor™ (U.S. Patent 6,311,565)—a safe, cost effective, and nondestructive method for anchor rod examinations (Figure 6). Licensing opportunities for SoundAnchor™ are available through the SRNS business development group or by contacting ATG.

Figure 6. A field application of SRNS's SoundAnchor™ technology on an anchor rod at the SRS. SoundAnchor™ is a cost-effective, thorough, and safe means of examining buried tower anchor rods without laborious excavations.

Goal

ATG strives to maintain the highest level of meteorological monitoring capabilities for the SRS and beyond and is committed to providing products that meet or exceed the customer's expectations.

Figure 5. Forest Canopy Soil Moisture Monitoring System at P Area. The soil moisture probe (left, buried) and rain gauge provide real-time data into ATG's meteorological monitoring system.

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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
- Remote Sensing Application
- Tall Tower Meteorlogical Monitoring System
- The People of ATG
- WIND System

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