Atmospheric Technologies Group

Climatology

The Climatology Site, operated by the Atmospheric Technologies Group (ATG) of the Nonproliferation Technologies Section (NTS) of the Savannah River National Laboratory (SRNL), provides unique meteorological data for routine monitoring, special projects, research, and operations at the SRNL. The Climatology Site is located near the center of the Savannah River Site (SRS) in a fenced, grassy area 110 meters square (Figure 1). It contains a 60-meter tower, two buildings, and a concrete instrument pad. Data acquisition systems record and transmit meteorological data to the Weather Center (ATG's central data archive) every 15 minutes. The site serves as a convenient development and installation area for new projects.

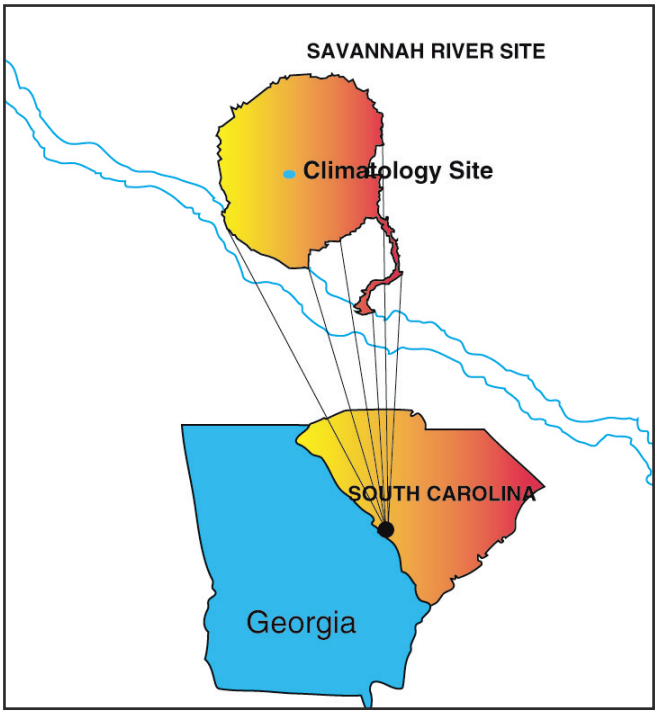

Figure 1. Savannah River Site map showing the Climatology Site location

Facilities and Instruments

Instruments currently located at the Climatology Site are listed in Table 1 and shown in Figure 2. The Climatology tower measures temperature, humidity, wind speed, direction and turbulence at four levels (2, 18, 36, and 61 meters). This excellent vertical resolution is valuable to characterize the atmospheric boundary layer, particularly during stable atmospheric conditions at night. Data are sampled every second and transferred to the ATG Oracle database every 15 minutes.

Table 1. Sensor Data Summary

Tower Instruments at 2*,18, 36, and 61 meters		
Wind direction	Met One bivane, Model 1585	
Wind speed	Met One cup anemometer Model 1564Bs	
Temperature	Met One platinum resistance Model T-210	
Dew point	Met One DP 200-B	
Aspirators	Met One 327-C	
Pad Instruments		
Soil temperature	Met One T-210	2.5,15.2, 30.5 cm
Solar radiation	Eppley black & white pyrheliometer 8-48	2 meters
Direct solar radiation	Eppley pyrheliometer 3060	2 meters
IR radiometer	Eppley PIR	2 meters
Rainfall	Belfort tipping bucket 5-405HA	1 meter
Evaporation pan	Qualimetrics 6844-A	0.2 meter
Wet & dry precipitation	Aerochem Metric 301	1 meter
Remote Sensing Instruments		
SODARS	XonTech bistatic	60-800 meters
Instruments in 623-27G		
Atmospheric pressure	Rosemont 1332A10	2 meters
Atmospheric pressure	Princo mercury barometer	1 meter

**Raised to 4.5 meters in May 1993*

Figure 2. The 60-meter Climatology Tower, showing the aspirated temperature sensors at 2 meters and bivane and anemometer at 4 meters.

Field instruments near the base of the tower include soil temperature probes, short and long-wave radiometers, a pyrheliometer, rain gage, evaporation pan, and deposition pans. The short wave radiometer (pyranometer, Figure 3) measures solar direct and diffuse radiation between 0.28 and 2.8 microns. The pyranometer is also used to estimate cloud cover during daytime by comparing the measured radiation to the expected clear sky value. The pyrheliometer (Figure 4) measures radiation from the solar disk between 0.5 and 2.8 microns for special projects.

Figure 3. The Epply black and white solar (whole sky) pyranometer

Figure 4. Eppley (sun following) pyrheliometer and solar tracker

Figure 5. The tipping bucket rain gage and wind screen

Recently two more radiation instruments have been added to the Climatology Site. The Multi-Filter Rotating Shadowband Radiometer measures the diffuse and direct broadband solar radiation and also radiation at six specific wavelengths between 0.415 and 0.940 microns. From this data the overhead amounts of aerosols, water vapor and ozone can be calculated. The Precision Infrared Radiometer measures the downward infrared radiation between 3 and 50 microns.

The rain gage (Figure 5) is a tipping bucket type that records rainfall every 15 minutes. The evaporation pan (Figure 6) is a stainless steel pan 1.3 meter across, with sensors that measure the average water level and water temperature. This data measures evaporation and rainfall for each 15-minute period.

A barometric pressure sensor located in the Climatology data building records barometric pressure to 0.5mb accuracy and is used for a variety of purposes.

Some instruments at the Climatology Site, such as SODARS (Figure 7), are used for special purposes. SODARs are sound radars and measure winds and turbulence up to 1000 meters by transmitting a sound pulse and analyzing the return echo. These instruments supplement the SRNL tower system and have been used for various special projects. An example of a SODAR return echo is shown in Figure 8. This graph illustrates the growth of the planetary boundary layer from 200 to 600 meters in the morning.

Uses of the Climatology Site

High quality Climatology data has been archived since 1990. This data has been used for many different purposes, including environmental and engineering studies. Of particular importance are the 4-meter surface meteorological data that are obtained in a relatively open area away from trees and buildings. The surface (4 meters) and near surface wind data (18m) are becoming increasingly important for operational wind forecasting and monitoring. Often outdoor operations require winds that are below some threshold value. Since these opeations are usually at ground level, the 4 or 18 meter Climatology tower measurements are preferred.

Figure 6. The evaporation pan and float assembly

Figure 7. Vertical bistatic SODAR antenna

In 1997 SRNL began monitoring and forecasting heat stress during warm months of the year. Traditionally, the heat stress index has been measured with a hand held, manually read instrument. In order to automate this process, SRNL scientists developed and tested a method that determines the heat stress index from the Climatology temperature, humidity, wind speed and solar radiation measurements. The heat stress index is displayed on the SRS Weather Center's web site.

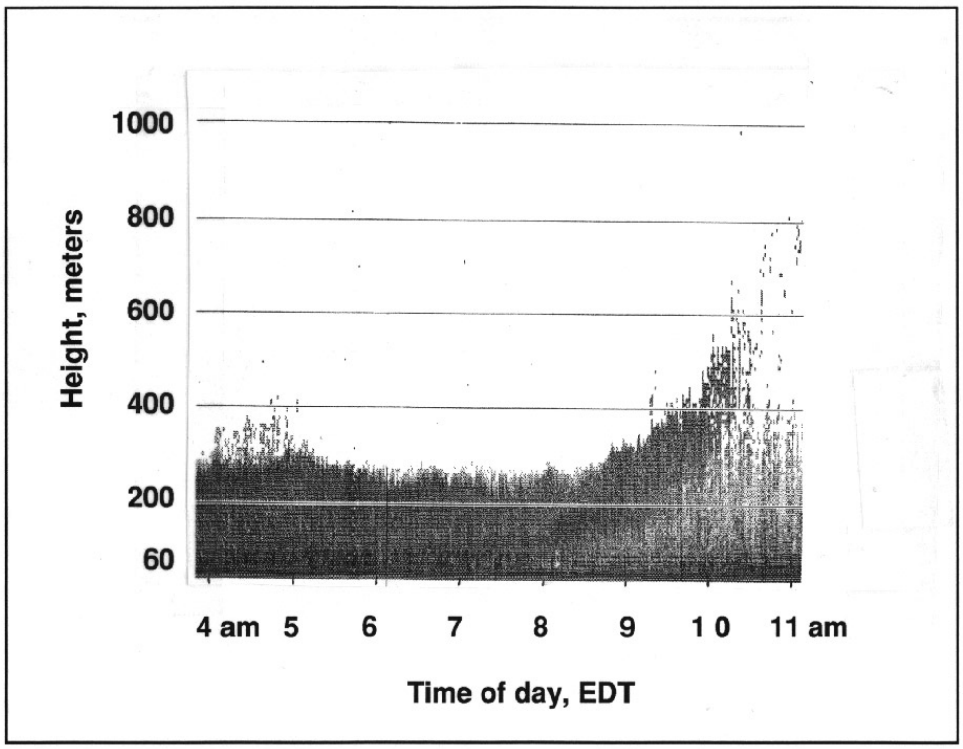

Figure 8. SODAR echo image showing nighttime and early morning growth of the atmospheric boundary layer at the Climatology Site.

The Climatology Site also supports research projects for on-site and off-site customers. For example, in 1999 analysis of changes in the sludge level in high-level waste storage tanks suggested that these fluctuations were caused by natural variations in the atmospheric pressure. A follow-up study with pressure data from the Climatology Site confirmed this relationship.

The NTS has been a participant in DOE's Multispectral Thermal Imager satellite project from 1997-2001. SRNL's role in this project is to compare satellite measurements with surface data (ground-truth). The Climatology Site functions as one of the ground truth targets for this mission.

In 2001 the Climatology Site joined the National Atmospheric Deposition Network as an atmospheric mercury deposition site. Deposition of mercury is sampled weekly and combined with data from locations throughout the US.

Future Plans

The mission of the Climatology Site is twofold: to provide a convenient functional facility for special projects, and to generate a high-quality continuous database of environmental data for current and future users. For this reason, enhancements to the facility are planned with future applications in mind. These include measurements of broadband IR radiation and of the direct and diffuse solar components. More accurate humidity sensors will also be installed on the 60-meter tower to estimate the vertical flux of moisture through the boundary layer.

FOR MORE INFORMATION

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