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GEORGIA FOREST RESEARCH PAPER

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JAN., 1984

# THE APPLICATION OF THE FORESTRY WEATHER INTERPRETATIONS SYSTEMS (FWIS)

# TO FOREST MANAGEMENT PROBLEMS IN GEORGIA

by James T. Paul and James C, Turner, Jr.

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# The Authors

James T. Paul is a research forester/ meteorologist at the Southern Forest Fire Laboratory, Southeastern Forest Experiment Station, Macon, Georgia. He is currently Project Leader of the Forestry Weather Data System Research Work Unit. He received his BSF, MS and PhD from the University of Georgia with one year of course work in meteorology at the University of Texas.

James C. Turner, Jr. is retired Chief of Forest Protection, Georgia Forestry Commission, Macon. Since joining the Commission in 1947, he has held a number of responsible positions in various divisions. He received his Bachelor of Science in Forestry from the University of Georgia in 1947.


*Figure 1 --An example of a computer terminal with built-in acoustical coupler, which can be used to access the Forestry Weather Interpretations System (FWIS).*

# (FWIS)
# The Forestry Weather Interpretations System

## Designed to provide the forest manager with current weather data for specific locations

by

James T. Paul and James C. Turner, Jr.

Area weather reports of a general nature do not provide sufficient information for adequate planning of many forestry operations. The forest manager frequently needs weather forecasts for specific small-size forest management units or stand from 24 to 72 hours in advance to adequately plan certain operations. Planning and execution of prescription fires and related smoke management, tree planting, and nursery activities are examples of projects that can benefit from detailed, site-specific weather information.

The Forestry Weather Interpretations System (FWIS) was designed to provide the forest manager with current weather data for specific locations. All weather data in the system originate with the National Weather Service (NWS) observational sites or forecast offices. In Georgia there are 16 surface weather observational locations, two upper-air stations, and a forecast office (figure 2). A mathematical interpolation procedure which uses the seven nearest weather stations provides estimates of weather (either forecast or observed) at any user-supplied latitude and longitude. In Georgia, a square unit of 0.10 degrees on a side is about 30,000 acres.

No previous training in meteorology or computer science is required to use FWIS, and the system can be accessed using a low-speed computer terminal (figure 1) and a common voice-grade office or home telephone. The five easy-to-follow steps necessary to access a product are:

1. Dial the computer.
2. Logon (type your identification code when requested).
3. Ask for a product.
4. Enter any special information when requested, such as latitude and longitude, fuel type, etc.
5. Logoff (terminate the session).

Detailed instructions on logon procedures and system products are available in a user manual (Paul and Clayton 1978) and in the system-resident FWIS help routine.

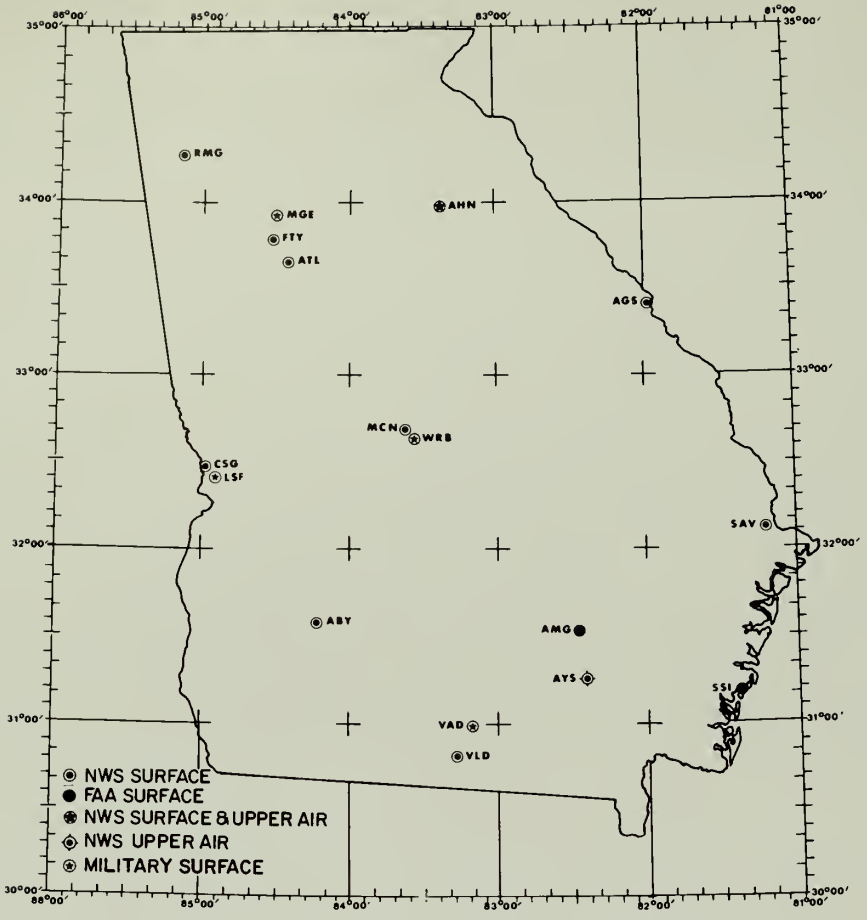


*Figure 2 --Hourly surface and upper-air observing stations in Georgia.*

*NWS Surface Stations*
*RMG - Rome, Ga.*
*FTY - Fulton County*
*ATL - Atlanta, Ga.*
*AGS - Augusta, Ga.*
*MCN - Macon, Ga.*
*SAV - Savannah, Ga.*
*ABY - Albany, Ga.*
*CSG - Columbus, Ga.*

*FAA Surface Station*
*AMG - Alma, Ga.*
*SSI - Saint Simons Isl., Ga.*

*NWS Surface & Upper Air Station*
*AHN - Athens, Ga.*

*Military Surface Stations*
*MGE - Dobbins AFB*
*WRB - Warner-Robins AFB*
*LSF - Lawson AAF*
*VAD - Moody AFB*

*NWS Upper Air Station*
*AYS - Waycross, Ga.*

## OBSERVATIONAL DATA

Data and system products based on hourly observational data are usually available by 20 minutes past the hour. The hourly products (product name in bold type) are:

### Surface

FORLST - The latest observation at an airport location including temperature, relative humidity, wind, cloud cover, pressure, 1 - and 10-hour timelag fuel moisture, and a low-level stability index for user-selected stations (selected from those shown in figure 2) are printed on request.

OBSI - Data from the seven nearest stations are used to estimate an observation at any latitude and longitude in the U.S. east of Denver, Colorado.

MAP - Variation in current observed weather over an area is a useful planning tool and aids in "surprise prevention." Individual weather elements (temperature, relative humidity, etc.) from the surface observing stations are gridded and printed to the user's terminal with the states outlined in the background. Figure 3 is an example of a relative humidity map for the Southeast.

### Upper Air

An upper-air probe is released each day at 0700 and 1900 EST at Waycross and Athens to measure the state of the atmosphere above the surface. The air layer occupying the first few thousand feet above the surface has a direct bearing on many forest operations.

Fire control, prescribed burning/smoke management, aerial spraying, and the transport of pathogenic fungal spores are examples of events that are influenced by weather at the surface and upper levels.

UAOB - The wind, temperature, dewpoint, and pressure up to about 25,000 feet can be listed to a user's terminal.

STAB - This product estimates how transport windspeed, mixing height, and stability class vary throughout the day. Transport windspeed can be used to estimate the distance smoke, fungal spores, or insects may move in a given time period. The mixing height is used in smoke management and by scientists developing fungal and insect dispersion models.

## FORECAST DATA

The NWS provides forestry weather forecasts in Georgia for today, tonight, and tomorrow. The data are entered into FWIS directly from the Forecast Office in Atlanta using a telephone hookup linking a NWS computer and the University of Georgia computer. From these data the following products are available:

FDFCST - English text forecast by Georgia Forestry Commission District.

FWFCST - English text forecast for the state.

CNTY - English text forecast by selected counties.

FORCST - Digital spot forecast by latitude and longitude for today, tonight, and tomorrow.

## FOREST FIRE MANAGEMENT PRODUCTS

Special products in the system are designed to aid the forester in determining the impact of weather on specific management activities.

RXBURN - For a prescribed burn, the user enters location, time of burn, stand, fuel, and fire prescription characteristics and receives:

1. An evaluation of local weather as it relates to the burn.
2. An evaluation of the chances of smoke from the burn drifting into an EPA-defined non-attainment area.
3. An estimate of the particulate concentration downwind from the fire.

HRSMOK - This is a smoke management planning tool that allows a forester to enter various combinations of fire, fuel, and weather variables, and play "what if" with downwind concentrations values. It is designed to illustrate the effect of a fire's change in rates of emission and heat-release and effect of diurnal weather variations on concentrations, which may not correspond to the time of highest smoke emissions or to combustion activity. User inputs are fuel, fire behavior, and weather information.

SMKLCR - Describes the odds of a user's smoke impacting on an EPA-defined non-attainment area. (Same as part 2 of RXBURN above but designed to accomodate those users who only need information relating smoke from their burn to non-attainment areas.)

GAMAP - Temperature, relative humidity, wind direction and speed, 1-hour fuel moisture, and stability class values are arranged around a map point representing a NWS observing station and printed to the user's terminal with the state and GFC district boundaries as a background. This provides the fire manager with a spatial representation of the weather and fire variables across the state.

REGION - A general overview of major passing and developing weather patterns will impact on fire management and other forestry operations for today, tonight, and tomorrow.

STACK - Provides a rough estimate of the air quality impact produced by a single industrial stack source during a 24-hour time span. This product is used by managers who must evaluate the impact of smoke from new industry on air quality protected wildlands.

## SYSTEMS UTILIZATION

In Georgia, the Georgia Forestry Commission (GFC) Protection Division has been the major FWIS user. Their use is largely a function of the severity of the wildfire protection problem. In general, system access increases with acres burned by wildfire and drops as the fire problem decreases (figure 4).

## OTHER SILVICULTURAL USES

RUSTY - When relative humidity above 92 percent, temperature above 60°F, and low windspeed all occur simultaneously, fusiform rust spore production is enchanced (Snow et al. 1968). There are at least two ways that accurate spot weather forecasts can aid in the control of fusiform rust. First, according to Davis and Snow (1971), an additional nursery spray application of fungicide when these

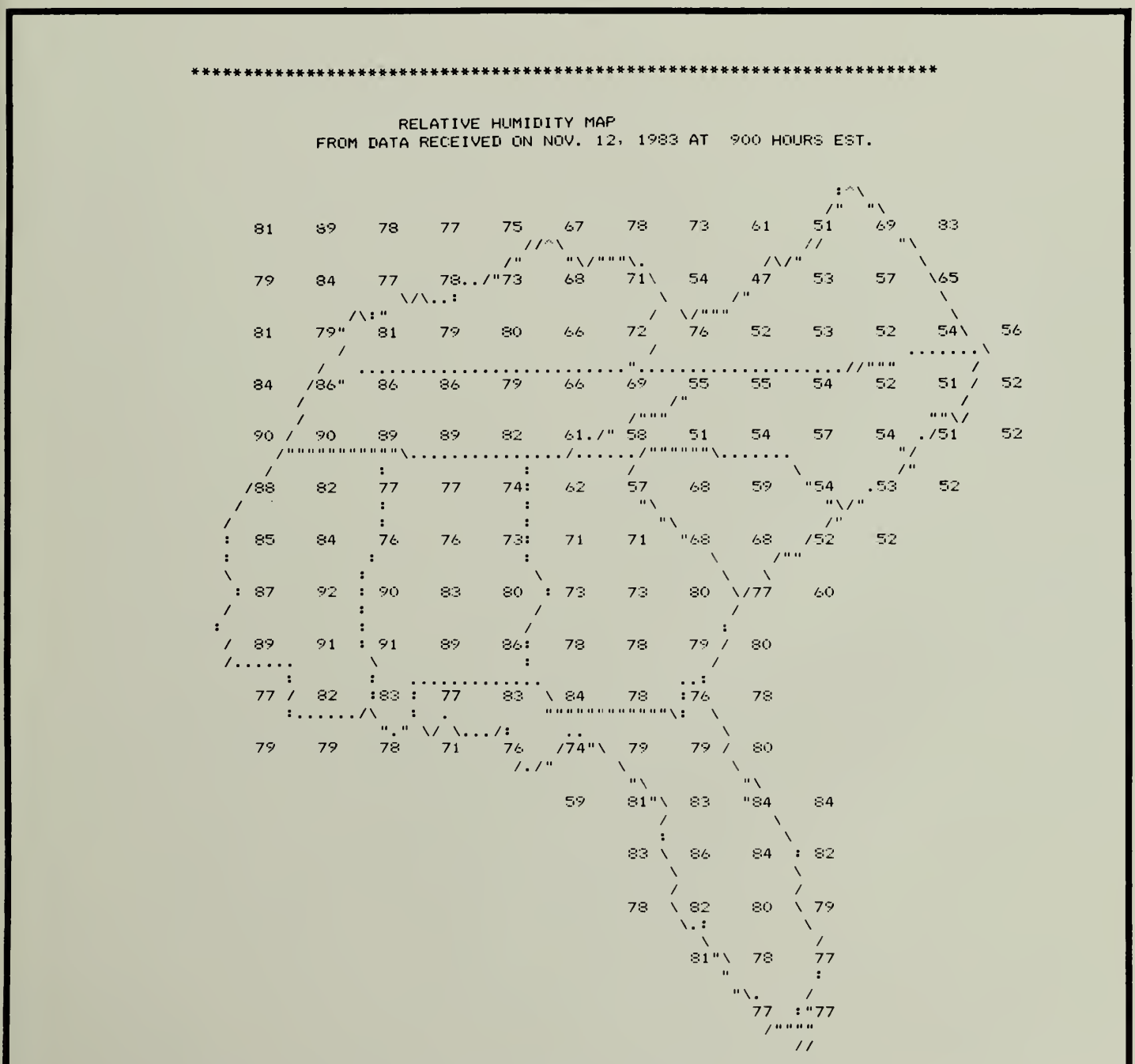


*Figure 3. --Relative humidity map for the souhteastern United States.*

weather conditions occur has the potential to reduce seedling losses. Second, when nursery seedlings are outplanted, chances of fusiform rust infections are frequently at or near 100 percent on some sites (Powers et al. 1975). Work by Rowan (1982) indicates that Bayleton® [1/] is effective in reducing fusiform rust if spray is applied within 14 days after infection. By storing estimated weather at plantation sites in a computer, a manager could then evaluate the probable occurrence of a "fusiform rust incident" and decide if Bayleton® (or other systemic that might be developed) would be appropriate.

SPB - A number of southern pine beetle user decision models based on the results of work by various researchers as reported on by Anderson et al. (1982), are available in FWIS. These models project spread and damage of the southern pine beetle based on stand, soil, and weather data.

## Regeneration

Clearcut areas to be regenerated to forest stands are typically cleared of most residual vegetation and debris and then left fallow for a few weeks or months (figure 5). No specific model has been developed that relates recent past, current weather at planting time, and future (1 to 7 days) weather to seedling survival. However, current weather (OBSI, FORLST), and forecast weather (FWFCST, CNTY, FORCST) and REGION can be used to evaluate the potential of adverse weather at a planting site. For example, high mortality usually occurs when seedlings are planted on exposed sites and left under conditions of high moisture stress such as dry or frozen soil, extremes in air temperature or low humidity. However, planting schedules can be adjusted to avoid high risk based on short-term forecasts of freezing temperatures, low humidity, and low probability of precipitation.

TBCP - The Total Biomass Cruise Program (TBCP) (Clark and Field 1981) has been a FWIS product since the fall of 1981. TBCP estimates the weights and volumes of total trees, sawlog, pulpwood, fuelwood, and logging residue from standard tree cruise data. A forester enters cruise data and receives per acre and per tract biomass and forest product estimates at his terminal. In addition to its original objective, this program may have potential for estimating total fuel loading for use in fire and smoke management.

## Heat Stress/Wind Chill

Field foresters in Georgia are exposed to the full range of weather extremes throughout the year. Some conditions are hazardous to human health and safety. Among these potentially harmful weather

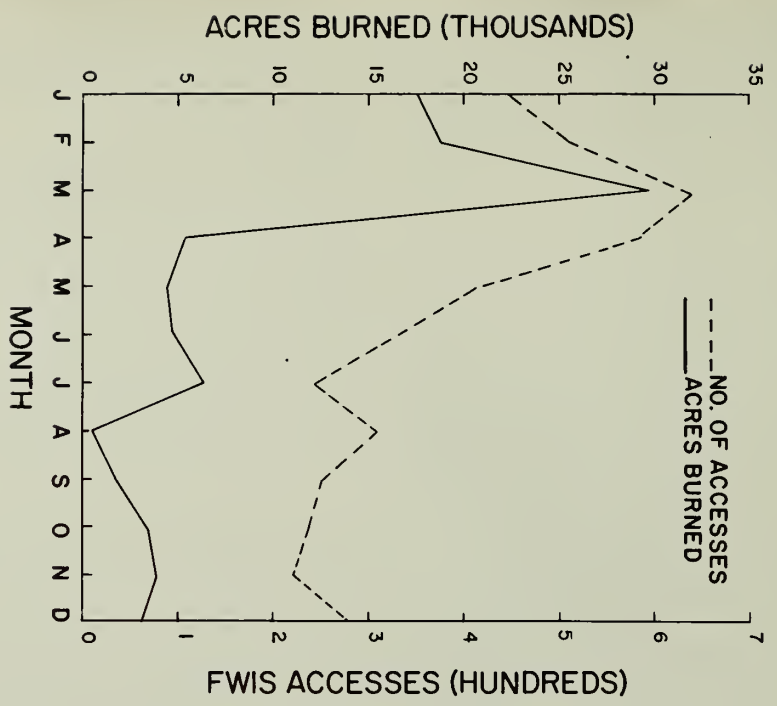


*Figure 4. --Number of FWIS accesses by the Georgia Forestry Commission and total acres burned by wildfire by month.*

conditions are wintertime low temperature and high windspeeds, which can reduce the efficiency of field workers and in extreme cases result in physical impairment. Conversely, in the summer, high temperatures (100 + $^{o}$F is not uncommon) and humidity may result in thermal stress that reduces the ability of workers to continue productive activity or which may be harmful to their health. The effect of these extreme conditions can be minimized by rescheduling field activity around expected extremes or by adjusting work hours. Wind chill values are calculated from hourly data and are available in OBSI and FORLST. A heat stress model is being adapted to forested conditions and is expected to be field tested during the summer of 1983. When combined with forecast data, these two indices will give the forest manager an added tool for planning field work.

These are just a few of the potential uses of timely local weather information for improving the efficiency of silvicultural activities. Many of the basic relationships between weather and biological response are not yet fully understood, but as additional models are developed for forestry application, FWIS can be used to deliver an easily accessed operational product to the field forester.

*Figure 5. --Typical cleared regeneration site near Macon, Georgia.*

[1/] Bayleton is a registered trademark of Farbenfabriken Bayer Gmbh, Leverkusen, West Germany.

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## GLOSSARY

Mixing height - The vertical extent of the volume of the atmosphere available for the dispersion and dilution of surface-based emissions. It is the height to which significant low-level mixing occurs--the effective cap on the lower portion of the atmosphere.

Non-attainment area - Region for which air-quality loadings of one or more regulated pollutants exceed air-quality standards.

One-hour timelag fuels - Fuels consisting of dead herbaceous plants and roundwood less than about one-fourth inch in diameter. Also included is the uppermost layer of needles or leaves on the forest floor.

Stability index - A number related to the direction and magnitude of vertical motion in the atmosphere. Most index values are small or negative for unstable or upward moving air with larger positive numbers indicating downward vertical motion.

Ten-hour timelag fuel moisture - The moisture content of the 10-hour timelag roundwood fuels.

Ten-hour timelag fuels - Dead fuels consisting of roundwood in the size range of one-fourth to 1 inch and very roughly the layer of litter extending from just below the surface to approximately three-fourths inch below the surface.

Timelag - The time necessary for a fuel particle to lose approximately 63 percent of the difference between its initial moisture content and its equilibrium moisture content.

Transport windspeed - The unweighted average of all windspeeds through the mixing depth.

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John W. Mixon, Director
J. Fred Allen, Chief of Research

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