NEW SYSTEM WILL LOCALIZE AND INTERPRET WEATHER
INFORMATION FOR NURSERYMEN

James T. Paul [1]

Abstract.--A system for storing and retrieving weather data
is being developed to provide localized and specialized forecasts
and information, for forestry problems. The general operation of
the system, user decision models, and a sample user interaction
with the system are included.

INTRODUCTION

The U. S. Forest Service, National Weather Service, the Georgia Forest
Research Council, various Southern State Forestry organizations, and private
industry are cooperating in a 2-year experimental weather program for the
forestry community. The objective is to provide localized weather informa-
tion and forecasts that help solve a wide range of forestry problems from
fire to nursery practice. The system will store and retrieve weather data,
interpolate between weather stations, and apply user decision models to pro-
vide the necessary special information. This paper describes the system and
those components that have specific application to nursery practices. A
model that gives the probability of fusiform rust infection at a specific
time and place should be especially useful to nurserymen.

The system will be monitored and operated by National Weather Service
(NWS) and Forest Service meteorologists at Macon who will work closely with
the NWS forestry focal point forecaster in each state. In addition, the NWS
meteorologist at Macon will develop a training plan for forestry focal point
forecasters that will enhance their understanding of forestry's special
weather requirements. The system will be designed jointly by the University
of Georgia Center for Computing Activities and the Forest Service.

PRIMARY DATA FLOW

Figure 1 shows how data flow through the system. Two IBM 1620 computers
at the Southern Forest Fire Laboratory at Macon, Georgia, are used for ac-
quiring data, for initial editing, and, in conjunction with other remote
terminals used by meteorologists at Macon, for monitoring, updating, and veri-
fying system operation. Data from National Weather Service (NWS) airways
stations (fig. 2 and table 1) enter the 1620 from a teletype line each hour.
The data are filtered, reformatted, and partially edited before transmission
to a CDC CYBER-74 computer at the University of Georgia, where the data pass
through a final editing routine before storage on a random access disk. Data

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[1] Research Forester/Meteorologist, Southern Forest Fire Laboratory,
Southeastern Forest Experiment Station, USDA Forest Service, Macon, Ga.

Figure 1.--Basic data flow.
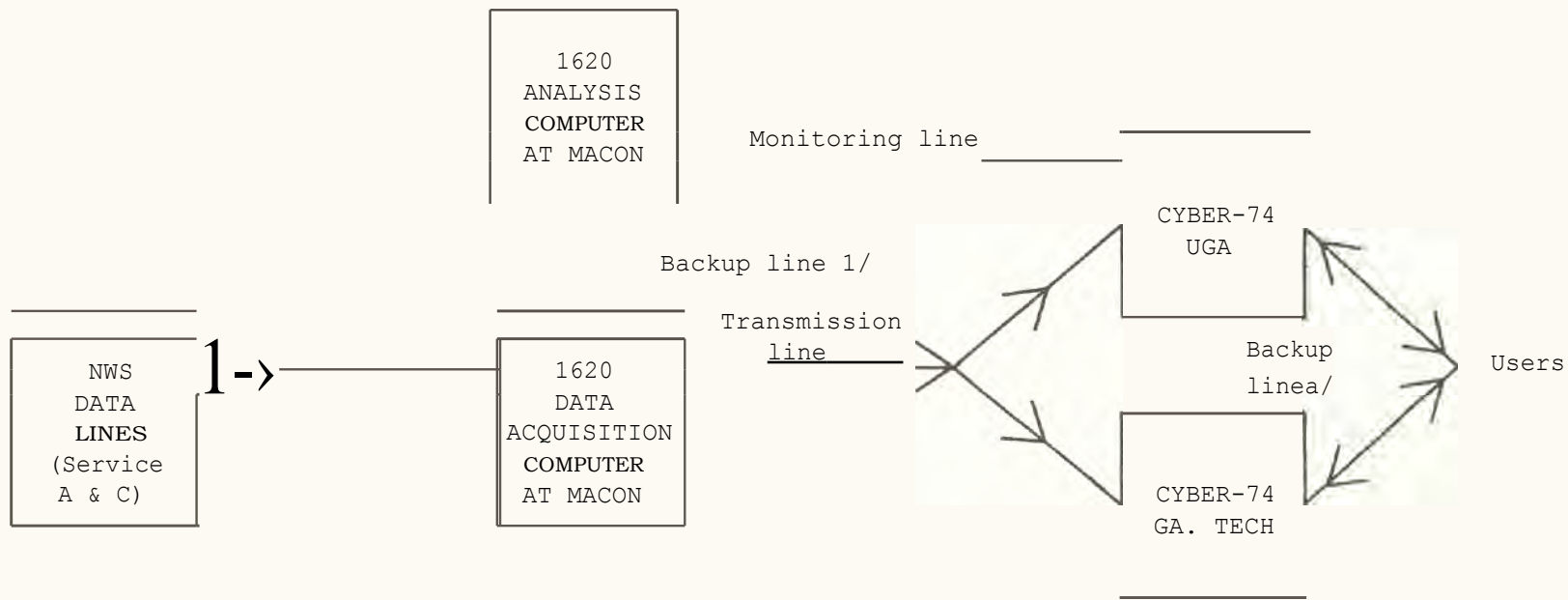
1/ Either 1620 can acquire data. If the data acquisition computer is down, the analysis 1620 will be switched on to acquire incoming data.

2/ The edited data, interpolation and user programs will be on disks at University of Georgia and Georgia Tech. If University of Georgia is down, the user will be automatically switched to Georgia Tech.
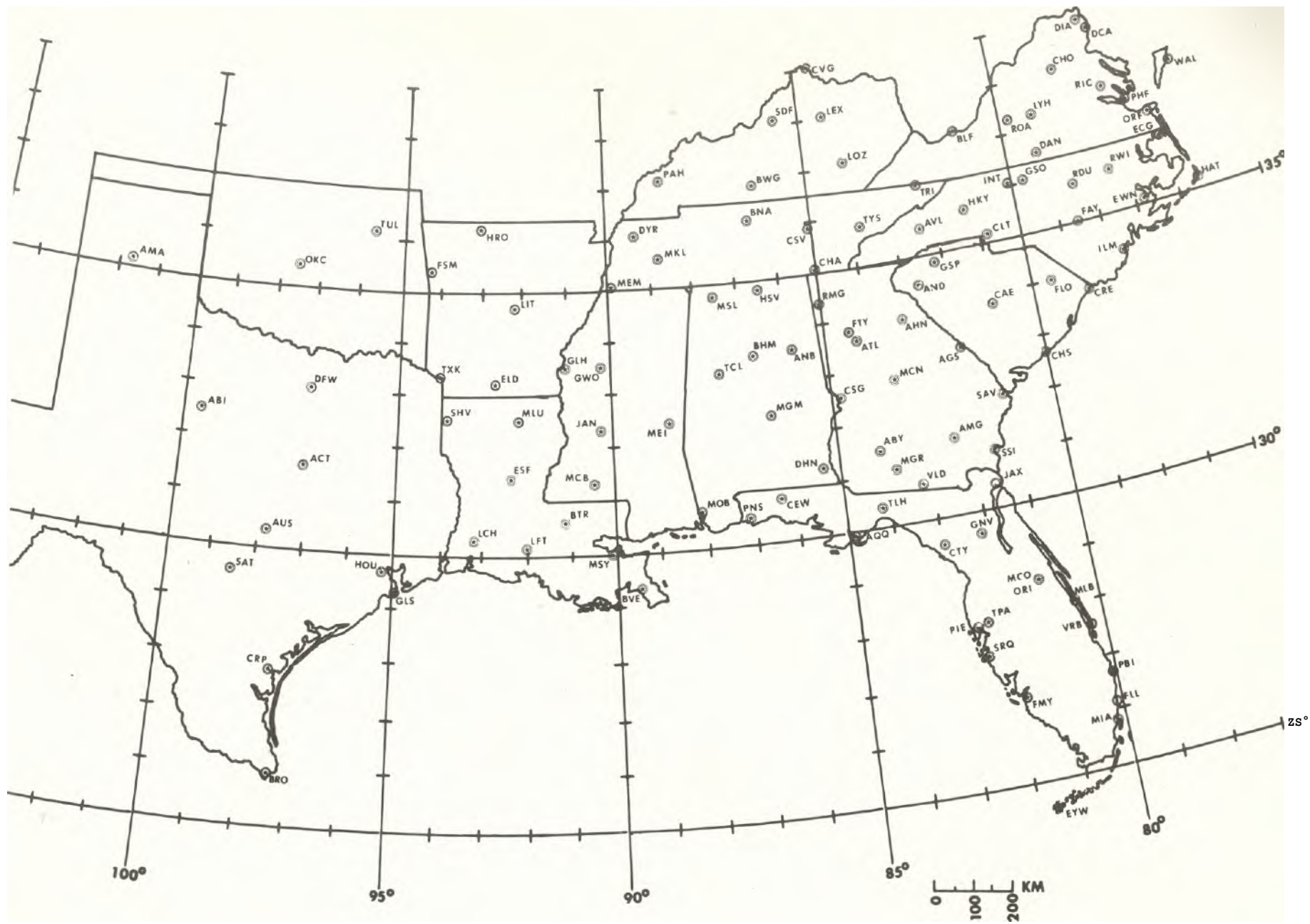
Figure 2.--National Weather Service weather stations used in the system (see table 1 for explanation of station identifiers).

Table 1.--Station directory

Station identifier	Station number	Latitude	Longitude	Station elevation	Station name and location
AGS	1	33.369	81.967	148	Augusta, Ga.
AHN	2	33.949	83.327	811	Athens, Ga.
CSG	3	32.516	84.939	394	Columbus, Ga.
DAB	4	29.181	81.056	35	Daytona Beach, Fla.
TPA	5	27.967	82.533	11	Tampa, Fla.
PBI	6	26.683	80.100	19	West Palm Beach, Fla.
CTY	7	29.633	83.100	42	Cross City, Fla.
RMG	8	34.349	85.159	643	Rome, Ga.
FTY	9	33.779	84.521	844	Charlie Brown Airport, Atlanta, Ga.
ATL	10	33.642	84.426	1034	Hartsfield Airport, Atlanta, Ga.
MCN	11	32.710	83.648	362	Macon, Ga.
ABY	12	31.535	84.195	193	Albany, Ga.
SAV	13	32.128	81.200	51	Savannah, Ga.
SSI	1)4	31.151	81.389	24	St. Simons Island, Ga.
VLD	15	30.763	83.279	223	Valdosta, Ga.
TLH	16	30.400	84.356	68	Tallahassee, Fla.
JAX	17	30.492	81.690	31	Jacksonville, Fla.
GNV	18	29.689	82.274	165	Gainesville, Fla.
MCO	19	28.433	81.317	106	Orlando, Fla.
MLB	20	28.100	80.633	27	Melbourne, Fla.
VRB	21	27.650	80.417	28	Vero Beach, Fla.
PIE	22	27.917	82.683	11	Pinellas County Airport, Fla.
FMY	23	26.583	81.867	12	Fort Myers, Fla.
FLL	24	26.067	80.150	10	Fort Lauderdale, Fla.
MIA	25	25.800	80.267	12	Miami, Fla.
EYW	26	24.550	81.750	21	Key West, Fla.
CEW	27	30.780	86.522	185	Crestview, Fla.
PNS	28	30.333	87.300	32	Pensacola, Fla.
ANB	29	33.583	85.850	618	Anniston, Ala.
BHM	30	33.563	86.756	630	Birmingham, Ala.
DUN	31	31.317	85.450	353	Dothan, Ala.
HSV	32	34.643	86.776	644	Huntsville, Ala.
MGM	33	32.300	86.393	221	Montgomery, Ala.
MOB	34	30.683	88.250	202	Mobile, Ala.
MSL	35	34.746	87.611	562	Muscle Shoals, Ala.
TCL	36	33.221	87.611	186	Tuscaloosa, Ala.
BNA	37	36.127	86.682	605	Nashville, Tenn.
CHA	38	35.036	85.204	688	Chattanooga, Tenn.
CSV	39	35.951	85.085	1870	Crossville, Tenn.
MEM	40	35.050	89.979	284	Memphis, Tenn.

Table 1 (con.)

Station identifier	Station number	Latitude	Longitude	Station elevation	Station name and location
NIKE	41	35.600	88.917	422	Jackson, Tenn.
TRI	42	36.476	82.406	1525	Bristol, Tenn.
TYS	43	35.812	83.992	980	Knoxville, Tenn.
GWO	44	33.500	90.083	133	Greenwood, Miss.
JAN	45	32.317	90.083	331	Jackson, Miss.
MCB	46	31.183	90.467	422	McComb, Miss.
MEI	47	32.333	88.751	310	Meridian, Miss.
AND	48	34.495	82.708	773	Anderson, S.C.
CAE	49	33.941	81.120	225	Columbia, S.C.
CHS	50	32.899	80.038	48	Charleston, S.C.
FLO	51	34.188	79.724	151	Florence, S.C.
GSP	52	34.900	82.218	971	Greenville-Spartanburg, S.C.
AVL	53	35.434	82.540	2170	Asheville, N.C.
CLT	54	35.215	80.938	769	Charlotte, N.C.
EWN	55	35.085	77.050	24	New Bern, N.C.
FAY	56	35.000	78.883	196	Fayetteville, N.C.
GSO	57	36.085	79.941	886	Greensboro, N.C.
HAT	58	35.267	75.555	11	Hatteras, N.C.
HKY	59	35.740	81.391	1188	Hickory, N.C.
ILM	60	34.274	77.917	38	Wilmington, N.C.
INT	61	36.128	80.233	978	Winston-Salem, N.C.
RDU	62	35.867	78.783	441	Raleigh, N.C.
RWI	63	35.850	77.883	158	Rocky-Mount-Wilson, N.C.
BTR	64	30.535	91.150	76	Baton Rouge, La.
ESF	65	31.400	92.300	118	Alexandria, La.
LCH	66	30.120	93.217	32	Lake Charles, La.
LFT	67	30.200	91.992	42	Lafayette, La.
MLU	68	32.517	92.050	81	Monroe, La.
MSY	69	29.992	90.250	30	New Orleans, La.
SHV	70	32.467	93.817	259	Shreveport, La.
ETD	71	33.217	92.800	285	El Dorado, Ark.
FSM	72	35.333	94.367	463	Fort Smith, Ark.
HRO	73	36.267	93.150	1385	Harrison, Ark.
LIT	74	34.733	92.233	265	Little Rock, Ark.
TXK	75	33.450	94.000	399	Texarkana, Ark.
BWG	76	36.967	86.433	536	Bowling Green, Ky.
LEX	77	38.033	84.600	989	Lexington, Ky.
LOZ	78	37.083	84.083	1211	London, Ky.
PAH	79	37.066	88.767	413	Paducah, Ky.
SDF	80	38.183	85.733	488	Louisville, Ky.
CVG	81	39.050	84.667	877	Covington, Ky.
BLF	82	37.300	81.217	2867	Bluefield, W. Va.
DCA	83	38.850	77.033	65	Washington, D.C.
CHO	84	38.133	78.450	644	Charlottesville, Va.

Table 1 (con.)

Station identifier	Station number	Latitude	Longitude	Station elevation	Station name and location
DAN	85	36.567	79.333	59 0	Danville, Va.
IAD	86	38.950	77.450	323	Dulles Int'l. Airport, Va.
LYH	87	37.333	79.200	937	Lynchburg, Va.
ORF	88	36.900	76.200	30	Norfolk, Va.
PHF	89	37.133	76.500	51	Newport *News*, Va.
RIC	90	37.500	77.333	177	Richmond, Va.
R OA	91	37.317	79.967	1176	Roanoke, Va.
ABI	92	32.416	99.683	1790	Abilene, Texas
ACT	93	31.616	97.217	508	Waco, Texas
AMA	94	35.233	101.690	3604	Amarillo, Texas
AUS	95	30.300	97.690	621	Austin, Texas
DFW	96	32.899	97.038	596	Fort Worth/Dallas (DFW Airport), Texas
CRP	97	27.776	97.500	44	Corpus Christi, Texas
BRO	98	25.900	97.433	20	Brownsville, Texas
GLS	99	29.300	94.800	54	Galveston, Texas
HOU	100	29.642	95.279	62	Houston, Texas
SAT	101	29.535	98.467	794	San Antonio, Texas
ELP	102	31.800	106.400	3916	El Paso, Texas
OKC	103	35.400	97.600	130 4	Oklahoma City, Okla.
TUL	104	36.200	95.900	676	Tulsa, Okla.
HST	201	25.476	80.400	7	Homestead AFB, Fla.
CBM	202	33.650	88.450	214	Columbus AFB, Miss.
BIX	203	30.416	88.917	18	Keesler AFB, Miss.
MCF	204	27.850	82.517	13	MacDill AFB, Fla.
MGE	205	33.916	84.517	1068	Dobbins AFB, Ga.
MYR	206	33.683	78.939	25	Myrtle Beach AFB, S.C.
NBC	207	32.483	80.708	38	MCAS Beaufort, S.C.
NSE	208	30.729	87.017	200	NAS Whiting, Fla.
NZC	209	30.217	81.883	80	NAS Cecil, Fla.
OZR	210	31.267	85.717	305	Fort Rucker, Ala.
PAM	211	30.067	85.583	18	Tyndall AFB, Fla.
POB	212	35.159	79.017	218	Pope AFB, N.C.
S SC	213	33.967	80.467	241	Shaw AFB, S.C.
SEM	214	32.333	86.983	166	Craig AFB, Ala.
VAD	215	30.967	83.204	233	Moody AFB, Ga.
VPS	216	30.476	86.535	85	Eglin AFB, Fla.
WRB	217	32.633	83.600	294	Robins AFB, Ga.
NIP	218	30.233	81.683	22	NAS Jacksonville, Fla.

transmitted to the University of Georgia will include both observations and forecasts derived and supplemented from NWS products. Both the 1620 in Macon and the CYBER-74 in Athens will have a backup in case one of the primary computers breaks down. In Macon the "monitoring" 1620 would then be used for data acquisition and a second CYBER-74, probably at Georgia Tech in Atlanta, would be used as a backup to the CYBER-74 in Athens. Thus, users should always be able to obtain the data and forecasts needed.

USER DECISION MODELS

The system will provide the following information of special interest to nurserymen:

Region

A southern weather summary with parts as follows:

Part A.--A discussion of existing and expected weather patterns across the South drawn from existing NWS products and reformatted for the system.

Part B.--An interpretation of the impact of existing weather patterns on forest operations.

State

A forecast prepared by the Weather Service Forecast Office (WSFO) in each state with parts as follows:

Part A.--A forecast of important weather parameters (temperature, dew-point, windspeed, wind direction, precipitation, mixing height, etc.) for each state by zones.

Part B.--A proposed addition to the current forestry state forecasts which would discuss, by zones, the weather impact on forestry operations as in Part B of Region.

Format and content may vary from state to state depending on what forest users and NWS state forecast office agree is appropriate.

SPOTO-A

Uses current weather plus a combination of automatically and manually entered forecast data to provide a statement of current conditions plus expected conditions in increments of 3 hours up to 24 hours for a given latitude and longitude. Statement includes surface windspeed, relative humidity, fire danger rating, transport windspeed, and stability interpreted for burning, nursery, spraying, and harvesting operations according to seasons.

<u>RUSTY</u>

Incorporates site factors, presence or absence of infectious spores, and existing and forecast weather to predict probability (negligible, low, moderate, high) of seedling infection at a nursery or plantation by fusiform rust.

MIRE

Provides a 5-day outlook of the likely occurrence of precipitation that would make soils unworkable for equipment.

<div align="center">USER SYSTEM INTERACTION</div>

A computer terminal with a typewriter keyboard is needed to use the system. The terminal can be attached to a common office telephone line. A typical interchange expected between the CYBER-74 in Athens and a remote user is shown below. Rowan (block) letters denote information a user must supply, while the italicized letters represent information returned by the computer. To obtain the desired information, the user must answer a series of questions posed by the computer. For example, after dialing and establishing a success-ful link, the computer responds with the first two lines and asks for *"USER NUMBER."* On line three the user types Smokey, Owl, and the computer responds with additional output.

Time 1600 (User dials the computer)

76/03/09.   1600.24.01
UGA CYBER 74. NOS 1.1 – 419/420.
USER NUMBER: Smo key, Owl
TERMINAL: 53, TTY
RECOVER/SYSTEM: Batch
SSRF L, 30000.
/LGO,I = WEASYS, L = 0
FOREST SERVICE/WEATHER SERVICE FOREST METEOROLOGICAL INTERPRETATION SYSTEM.
THE DATE IS 9 MARCH 1976 1600 EST.
REGION?
Yes
PART A – WEATHER
Yes

REGIONAL SYNOPSIS PREPARED 1500 EST TUESDAY MARCH 9, 1976
SIGNIFICANT FEATURES TUESDAY PM

REGION DOMINATED BY SURFACE HIGH PRESSURE RIDGE FROM SOUTH
TEXAS NORTHEASTWARD THROUGH WEST VIRGINIA. COLD FRONT MOVING
SOUTHWARD THROUGH SOUTH FLORIDA. SURFACE LOW PRESSURE CENTER
MOVING EASTWARD GREAT LAKES REGION WITH COLD FRONT MOVING
SOUTHWARD INTO OHIO VALLEY.

<u>(TENTATIVE FORMAT ONLY)</u>

SIGNIFICANT WEATHER FOR WEDNESDAY

UPPER LEVEL FLOW INDICATES EASTWARD PROGRESSION OF WEATHER
FEATURES WITH LITTLE NORTH-SOUTH MOVEMENT. SURFACE COLD FRONT
WILL REACH VIRGINIA-NORTH CAROLINA BORDER BECOMING QUASI-STATIONARY
WESTWARD THROUGH KENTUCKY, MISSOURI, AND KANSAS, INTO DEVELOPING
MAJOR STORM SYSTEM SOUTHEAST WYOMING. COLD FRONT MOVING EASTWARD
FROM UTAH-CENTRAL CALIFORNIA. NORTH-SOUTH HIGH PRESSURE RIDGE
MICHIGAN-TO-GEORGIA. QUASI-STATIONARY FRONT FLORIDA STRAITS TO
SOUTH TEXAS.

OUTLOOK FOR THURSDAY

COLD FRONT MOVING SOUTHEASTWARD WESTERN PORTION OF REGION.
SHIFTING WINDS AND THUNDERSTORM LINE ACTIVITY MOVING EASTWARD
TO MISSISSIPPI RIVER. INCREASING SOUTHWESTERLY WINDS 15-25
MPH MISSISSIPPI, WEST TENNESSEE WESTWARD SHIFTING TO NORTHWEST
TO NORTH BEHIND COLD FRONT, INCREASING RELATIVE HUMIDITY MOST
AREAS. PRECIPITATION EXPECTED OVER MOST OF REGION BY FRIDAY
MORNING.

PART B - WEATHER IMPACT?

Yes

FORESTRY OPERATIONS - SIGNIFICANT WEATHER - WEDNESDAY

FIRE DANGER - REMAIN LOW, LOW LEVEL WINDS LIGHT AND VARIABLE
EAST OF MISSISSIPPI RIVER BECOMING SOUTHEASTERLY 10-20 MPH
LOUISIANA AND ARKANSAS, SOUTHERLY 10-20 MPH TEXAS AND OKLAHOMA
BECOMING 20-30 MPH DURING DAY. SOME DRYING OF FUELS CAROLINAS,
GEORGIA, ALABAMA, AND MISSISSIPPI.

PRESCRIBED BURNING - APPEARS BEST WEST OF MISSISSIPPI RIVER WHERE
LOW LEVEL WINDS ARE SUFFICIENT. POOR ELSEWHERE WHERE WINDS ARE
LACKING.

SMOKE DISPERSION - SAME AS ABOVE, VERTICAL DISPERSION GOOD EAST
OF MISSISSIPPI RIVER DURING AFTERNOON, HORIZONTAL DISPERSION POOR.

HARVESTING - CONDITIONS GOOD

PLANTING - CONDITIONS EXCELLENT

NURSERIES - CONDITIONS EXCELLENT

SPRAYING - CONDITIONS EXCELLENT EAST OF MISSISSIPPI RIVER,
MARGINAL LOUISIANA AND ARKANSAS, POOR TEXAS AND OKLAHOMA DUE TO
WINDS.

OUTLOOK FOR THURSDAY

FIRE DANGER -_LOW MOST AREAS

HARVESTING -_CONDITIONS GOOD FLORIDA, GEORGIA, CAROLINAS, VIRGINIA, SOUTHERN ALABAMA AND MISSISSIPPI. POOR ELSEWHERE DUE TO PRECIPITATION. CONDITIONS IMPROVING WESTERN PORTIONS OF REGION WHERE RAIN HAS STOPPED.

PLANTING -_CONDITIONS EXCELLENT

NURSERIES -_CONDITIONS EXCELLENT. FLORIDA PENINSULA WILL BE WATCHED FOR DEVELOPMENT OF FAVORABLE CONDITIONS OF TEMPERATURE, HUMIDITY, AND WIND FOR FUSIFORM INFECTION DURING WEEKEND.

SPRAYING -_CONDITIONS BECOMING POOR MOST OF REGION DUE TO WINDS AND PRECIPITATION ACTIVITY.

SMOKE DISPERSION -_GOOD

PRESCRIBED BURNING -_GOOD FLORIDA, GEORGIA, CAROLINAS, MARGINAL ALABAMA AND MISSISSIPPI DUE TO SHOWER ACTIVITY.

STATE FORECAST?

Yes

A. FIRE WEATHER FORECAST FOR MISSISSIPPI
*   ISSUED 0945 CST WEDNESDAY, MARCH 10, 1976.*

TODAY AND TONIGHT (ALL ZONES) -_CLEAR TO PARTLY CLOUDY. MAX TEMP 60'S. MAX RH 90 TO 100%. WIND MOSTLY SOUTH TO SOUTHEAST LESS THAN 3 MPH.

TOMORROW (ALL ZONES) -_INCREASING CLOUDS. MAX TEMP 70'S. MIN RH 40%. WIND SOUTH TO SOUTHEAST LESS THAN 3 MPH INCREASING TO 10 to 15 MPH DURING DAY.

OUTLOOK -_RAIN AND SHOWERS DEVELOPING IN ADVANCE OF APPROACHING COLD FRONT FRIDAY. SLOW CLEARING SATURDAY.

B. FORESTRY OPERATIONS – SIGNIFICANT WEATHER – WEDNESDAY – MISSISSIPPI

FIRE DANGER -_LOW. LOW LEVEL WINDS MOSTLY SOUTH TO SOUTHEAST LESS THAN 3 MPH.

PRESCRIBED BURNING -_POOR DUE TO LACK OF WIND.

SMOKE DISPERSION -_*VERTICAL DISPERSION GOOD DURING DAYS*
HORIZONTAL DISPERSION POOR.

HARVESTING -_*GOOD*

PLANTING -_*EXCELLENT*

NURSERIES -_*EXCELLENT*

SPRAYING -_*EXCELLENT*

SPECIAL USER MODEL

Yes

ENTER LAT AND LONG

31.3 90.1

MODELS?

SPOTO-A, RUSTY

03 09 76

LST

TIME	T	RH	WS	WD
18	60	53	05	18
19	60	53	05	18
20	59	57	04	18
21	58	62	04	19
22	58	75	04	19
23	56	80	02	19
00	55	91	00	00
01	53	92	00	00
02	53	93	00	00
03	52	93	00	00
04	52	93	00	00
05	51	94	00	00
06	51	93	00	20
07	53	90	00	20

PROBABILITY OF RUST INFECTION -_*LOW*

OTHER REQUESTS?

No

SMOKEY LOG OFF *16.04.50.*
SMOKEY SRU *1.000 UNTS*

(TENTATIVE FORMAT ONLY)

COSTS

Costs of the system to a typical nurseryman might be:

(1) Computer terminal--$1,400 to $6,000 depending on special features.

(2) Computer costs--about $200/year.

(3) Telephone charges--$0.18/minute at the FTS rate or about $0.36/minute commercial depending on distance.

The sample computer /user exchange can be printed in about 4 minutes with a 30-character per second terminal. During the 2-year operational experiment, computer costs will not be charged to a forest user who is participating in the experiment and estimating utility and worth of the system products. Therefore, a user could obtain information similar to the sample for a one time charge of $1,400 for a terminal and communications charges of either $0.72 FTS or $1.44 commercial. If sufficient resources become available for the experiment, communication charges and computer terminals will be provided to participants at no cost to the user.

IMPLEMENTATION TIMETABLE - TENTATIVE

The system will be implemented one state at a time, starting with Georgia during March of 1977. Georgia was chosen as the first state largely because the basic communications framework already exists. With expansion of the communications network, Florida and North Carolina will be added to the system in Fiscal Year 1977. Initial users within these states will be the State Forester's office, one or two other State Forestry offices other than the State headquarters, the NWS State forecast office, and the National Forests in each of these states. User costs for the experiment, including communication charges, will be paid by the Forest Service as part of the experiment. Other users within these states will have to pay the costs indicated to use the system.

Other states will be added as resources become available to fund communications and terminal charges for the NWS state forecast office, the State Foresters office, and the National Forests within that state.

User decision models of interest to nurserymen are developed to the extent indicated below:

Region.--First version being evaluated by U.S. Forest Service, Region 8, Office of Fire Management in Atlanta.

SPOTO-A. --Operational testing expected in late February 1977. Later versions that incorporate site factors should be available early in 1978.

RUSTY.--Ready for user testing by April of 1977.

MIRE.--Ready in mid to late 1978.

USER PARTICIPATION AND INQUIRES

   Accessing procedures and model descriptions will be published in a
User's Guide and will be available from the Southern Forest Fire Laboratory,
Macon, Georgia. Prospective users are encouraged to comment on the usability,
format, and content of the system as described in this paper. Comments or
inquires should be addressed to:

        James T. Paul, Team Leader
        Weather Interpretations Team
        Southern Forest Fire Laboratory
        P. O. Box 5106
        Macon, Georgia 31208
        Telephone 912-746-5191