THE GEORGIA FIRE WEATHER POINT FORECAST

Introduction

Over the last ten years fires in Georgia have burned an average of 45,000 acres each year. Also, about 1,000,000 acres are treated with prescribed fire each year. Control of wildfire and success in prescribed burning is highly dependant on weather.

This product was developed to provide a better tool for fire control, prescribed burning, and other forestry operations.

The Georgia automated point forecast system is based on the National weather service AVN MOS model data. The original data can be viewed at:

ftp://140.90.88.142/tdl/lan/avnmav.txt

These data are time interpolated to provide a value at each hour. Cloud amount(**Cld Amt**, Probability of Precipitation(**Prob Pcp**), and Precipitation amount(**Precip Amount**) are not continuous variables and additional experienced based rules are applied to these variables. Data are then spatially interpolated to a 0.5 degree grid using the Barnes exponential weighted method (Barnes 1964). A user requests a point forecast by entering a latitude and longitude. Data are then extracted from the grid using a bilinear interpolation method. Data are returned to the requesting user in the form shown in Table 1.

Table 1. Sample output from the POINT FORECAST process.

Estimations at 30.000 80.500 On Jul. 30, 2002

		General Weather						Smoke Managemant				
	Wnd Dir	Wnd Spd	Temp	R Hum	Cld Amt	Prob Precip Pcp	Precip Amount	Trans Wnd Spd	Mixing Height	Stab Cls	Dispn Index	VSBY Index
	Hr	(Deg)	(MPH)	Deg F		%	Code %	Inches	MPH		Ft	
1	230	4	77	84	1	0	0.000	6	29	7	1	6
2	230	4	77	86	1	0	0.000	6	29	6	1	6

Description of the POINT FORECAST output

In line 1, " Estimations at **30.000 80.500** On Jul. 30, 2002", 30.00 is latitude and 80.5 is longitude. These values were entered by the user. Latitude and Longitude can be extracted from most road maps. For the UTM (Universal Transverse Mercator) version, the user must enter the Zone , easting, and northing in the designated boxes. It is the users responsibility to enter correct data, since there is no process available at this time to check for errors. Data must be 6 digits with no leading zeros. For example

31112 would be entered as 311120

Hr is hour of day in local time.

Wnd Dir is surface wind direction , 0 - 360 degrees, in 10 degree increments. This follows the common meteorological tradition with wind being named as the direction **FROM** which the wind is blowing. For example a wind direction of 270 would indicate a west wind, 090 a east wind, 180 a south wind, etc.

Wnd Spd is the surface wind speed in miles per hour.

Temp is surface ambient air temperature in degrees Fahrenheit

R Hum is the surface relative humidity in percent.

Cld Amt is the coded cloud amount

0 = Clear - no clouds
1 = Scattered - 1 to 5 tenths of sky covered by clouds
2 = Broken - 6 to 9 tenths of sky covered by clouds
3 = Overcast - 10 tenths of sky covered by clouds
4 = Obscured - Upper level clouds not seen due to surface phenomena such as fog.

Prob Pcp is the probability that precipitation will occur in percent.

Precip Amount is the estimated amount of rain that will occur **IF** rain occurs at a location. Forecasts of rainfall amount are rough estimates, and should be viewed in relative instead of absolute terms.

Trans Wnd Spd is the transport wind speed which is the average of all wind speeds between the surface and the mixing height. Spotting and suspended particles from burning are typically transported at this speed. It is estimated using surface data.

Mixing Height is the thickness of the lower layer of the atmosphere where "mixing" occurs. Usually, it is in the order of a few thousand-feet during the day and on the order of a few hundred-feet at night. It is estimated from surface data.
In general, mixing height will be highest during daytime periods and lowest during nighttime periods. Heating, winds, etc. are some of the factors that determine how thick the mixing layer will become.

During the daytime, mixing height will be lowest at sunrise and should reach maximum thickness by mid-day. The thickness of this layer will normally decrease fairly quickly as sunset approaches.

A simplistic analogy would be the afternoon and evening thunderstorms that commonly occur in the south during the summer. As the maximum heating of the day approaches, the clouds start to boil upwards and eventually may form thunderstorms. Assuming no other potential influences (fronts, etc.), as sunset approaches, the heating that drives these thunderstorms is shut off. Often times, these thunderstorms will begin to dissipate soon after sunset.

Stab Cls is the Turner stability class (Turner 1961) which is a measure of atmospheric stability with values ranging between 1 and 7.

By definition, Turner values of 1, 2 or 3 are possible only during daytime periods and values of 5, 6 or 7 are only possible during nighttime periods. A Turner value of 4 is possible both during the day and night. Table 2 summarizes the relationship between Turner stability class and expected fire behavior.

Table 2. Turner Stability Class (Pasquill Stability Class): It is computed as a function of ceiling height, solar radiation, day/night period and wind speed. Turner (1961)

Turner Stability Class	Stability of the Atmosphere	Expected Fire Behavior
1	Extremely unstable	Erratic
2	Moderately unstable	Intense
3	Slightly unstable	Normal
4	Neutral	Normal
5	Slightly stable	Normal
6	Moderately stable	Subdued
7	Extremely stable	Subdued

Dispn Index is the smoke dispersion index which is a measure of the atmosphere's "diluting power". Values are relative in that an index of 48 would suggest that the atmosphere should be able to take twice the smoke as would be possible for an index value of 24. The atmosphere over a district or county can be viewed as a covered cake pan in simplistic terms. Even if the dispersion in this cake pan were good, it would still be possible to saturate the container with too much smoke. This index SHOULD NOT BE USED ALONE in the deciding whether to initiate or approve a burn. Description and interpretation of the range of smoke dispersion values can be found in Table 3.

No two cases are ever exactly alike. Thus, some reasonable judgment and common sense needs to be applied. The dispersion index as used in the GFC fire weather forecast is valid for the middle of the daytime periods and from the middle to last half of the nighttime periods.

Because the daytime dispersion index given is, say 50, does NOT mean that the dispersion index starts out at 50 for the given forecast period. There is a "time window" during the 12-hour forecast period when, if the forecast is correct, this dispersion index should be at or near 50.

At sunrise, dispersion is low normally. As the sun gets higher and induces more heating, the dispersion index will climb. At first, the amount of improvement will be minimal. About 3 or 4 hours after sunrise, the amount of improvement should be significant. On average, the best dispersion will be in the early to mid-afternoon. After this period, dispersion will start to degrade and towards sunset, it should drop like a "rock". Each case will be somewhat different as many factors enter into the equations.

Table 3. Smoke Dispersion Index Interpretation (Lavdas, 1986)

Dispersion Index	Interpretation
> 100	Very good (but may indirectly indicate hazardous conditions; check fire weather)
61-100	Good (Typical-case burning weather values are in this range)
41-60	Generally good (Climatological afternoon values in most inland forested areas of the United States fall in this range)
21-40	Fair (Stagnation may be indicated if accompanied by persistent low windspeeds)
13-20	Generally poor; stagnation, if persistent (although better than average for a night value)
7-12	Poor; stagnant at day (but near or above average at night)
1-6	Very poor (very frequent at night; represents the majority of nights in many locations)

VSBY Index is the Low Visibility Occurrence Risk Index (LVORI) which was developed based on Florida automobile accident reports when fog/smoke was a factor, and the associated weather (Lavdas and Achtemeier, 1995). It is an index for probability of low visibility, and ranges from 1 – 10, depending on relative humidity and smoke dispersion index. A 1 means there is almost no chance of low visibility, while a 10 indicates low visibility is likely.

From operational experience, one should be **VERY CAUTIOUS ABOUT BURNING** if one of the following situations occurs:

1. When LVORI for a nighttime forecast period is 8,9 or 10

2. When ACTIVE SMOKE from stumps logs, etc. is present during the night

3. When there is a roadway within three miles of a burn site with open fields, logging roads, or open streams that can provide an easy transit of the smoke from the burn site to the roadway

Although not as dangerous as an index value from 8 to 10, LVORI of 6 or 7 should be treated with caution if there is active smoke produced during the night, and the burn site is near a roadway.

LITERATURE CITED

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GLOSSARY

Definitions included in this glossary are mention in this help file, or those which provide a more detailed backgrounc

Note: * Indicates definitions extracted from (Southern Forest Fire Laboratory Staff., 1976).
** Indicates definitions extracted from (Deeming, et al. 1977).
Italic indicates editing by authors

AMBIENT AIR. - Literally, the air moving around us; the air of the surrounding environment. *

DISPERSION. - In air pollution terminology, loosely applied to the removal (by whatever means) of pollutants from the atmosphere over a given area; or the distribution of a given quantity of pollutant throughout an increasing volume of atmosphere. *

DRY-BULB TEMPERATURE. - The temperature of the air. **

EXTINCTION MOISTURE CONTENT. - The fuel moisture content, weighted over all the

INVERSION. - Temperature inversion. A layer *(of atmosphere)* in which temperature increases with altitude. *

MICRON. - One millionth of a meter, a micrometer. *

MIXING. - A random exchange of fluid parcels on any scale from the molecular to the largest eddy. *

MIXING HEIGHT. - The height *(in the atmosphere)* to which relatively vigorous mixing occurs (meters). *

PARTICULATE MATTER. - Any liquid or solid particles suspended in or falling through the atmosphere. *

PARTICULATE MASS CONCENTRATION. - The amount of particulate matter per unit volume of air (ug/m3). *

PLUME. - The segment of the atmosphere occupied by any of the emissions from a single source. A convection column, if one exists, forms a specific part of the plume. *

POLLUTANT. - With respect to the atmosphere, any substance within it that is foreign to the natural atmosphere or that exceeds its natural concentrations in the atmosphere. The universal connotation is that a pollutant is potentially deleterious. *

PRECIPITATION. - Any or all the forms of atmospheric water, liquid or solid, that reach the ground. (Usually measured to the nearest one-hundredth of an inch.) **

PRECIPITATION DURATION. - The time, in hours and fraction of hours, that a precipitation event lasts. More precisely, for fire-danger rating purposes, it is the length of time that fuels are subjected to liquid water during the day. **

RELATIVE HUMIDITY (RH). - The ratio of the actual amount of water vapor in the air to the amount necessary to saturate the air at that temperature and pressure. It is expressed as a percentage. **

RESPIRABLE SUSPENDED PARTICULATE MATTER (RSP). - That portion of the total particulate matter that, because of its size (below 2 to 3 microns in diameter), has an especially long residence time in the atmosphere and penetrates deeply into the lungs. Aerosol is used interchangeably for the smaller airborne particulate matter by many authorities. However, aerosols are more precisely defined as particles in a gaseous medium.

SOURCE. - A point, line, area, or volume at which mass or energy is added to a system, either instantaneously or continuously. Conversely, at a sink, mass or energy is removed. Examples of sources in the context of air pollution areas follows: a smokestack is a point source; a freeway or aircraft trajectory is a line source. *

TARGET. - Any place at which adverse effects of smoke concentrations may be experienced. *

TOTAL SUSPENDED PARTICULATE MATTER (TSP). - That portion of the total particulate matter that, because of its size (below 5 to 10 microns in diameter), is transported long distances in the atmosphere and has the greatest potential for environmental impact

TRANSPORT WINDSPEED. - A measure of the average rate of the horizontal transport of air within the mixing layer (meters per second). *

TURBULENCE. - A complex spectrum of fluctuating, disordered motion superimposed on the mean flow of a liquid or gas. *

WINDSPEED. - Wind, in miles per hour, measured at 20 feet above the ground or the average height of the vegetative cover, and averaged over at Least a 10-minute period. **