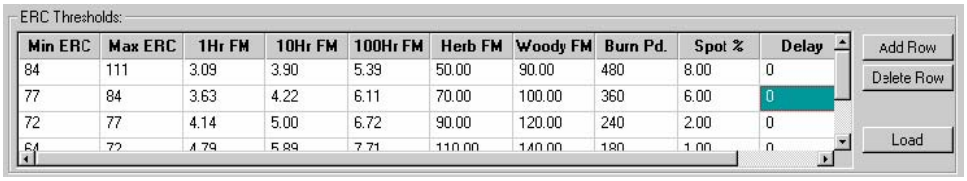
United States Department of Agriculture – Forest Service
Rocky Mountain Research Station

Executive Summary: The FSPro system (Fire Spread Probability)

The Fire Spread Probability model – FSPro, is a new fire modeling tool developed by Dr. Mark Finney from the Rocky Mountain Research Station's Missoula Fire Lab. This program has "roots" in the *FARSITE*/Flammap applications as well as RERAP. FSPro calculates the probability of fire spread from a current fire perimeter or ignition point for a specified time period. It requires GIS landscape data (LCP file) as provided by LANDFIRE or other sources. Additionally the application requires data from a representative NFDRS or RAWS station so as to develop a historical data set relative to wind and ERC (energy release component – see NFDRS).

The model simulates the 2-D growth of the fire across the landscape (fuels & topography) using a computationally efficient form of the *FARSITE* calculations. FSPro differs from *FARSITE* in that it simulates fire growth for thousands possible weather scenarios (1,000 – 10,000 individual simulations) using the latest recorded perimeter (or point). Different weather possibilities are developed statistically using the data from the weather station (fuel moisture, wind speed and direction). The probability for each cell is a calculation of counting how many times a cell burns divided by the total number of simulations.

Fuel moistures are classified by the user into 5 to 10 categories associated with ERC.

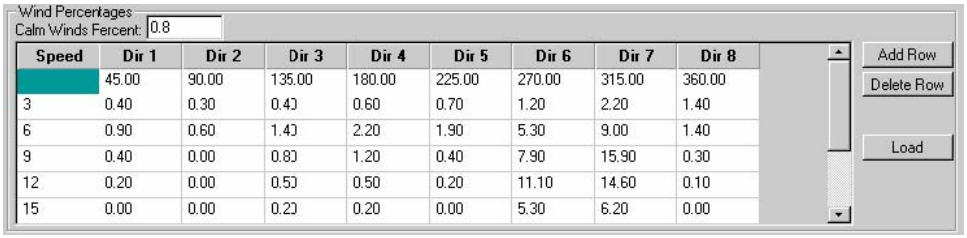

ERC Thresholds:

Min ERC	Max ERC	1Hr FM	10Hr FM	100Hr FM	Herb FM	Woody FM	Burn Pd.	Spot %	Delay
84	111	3.09	3.90	5.39	50.00	90.00	480	8.00	0
77	84	3.63	4.22	6.11	70.00	100.00	360	6.00	0
72	77	4.14	5.00	6.72	90.00	120.00	240	2.00	0
64	72	4.79	5.89	7.71	110.00	140.00	180	1.00	0

Add Row
Delete Row
Load

Each group has user-defined burning periods and spotting probabilities. Attributes of each category can be edited by the user.

Winds are grouped into categories by speed and cardinal direction. These wind data can be taken from a RAWS station to reflect hourly data during the burning period.

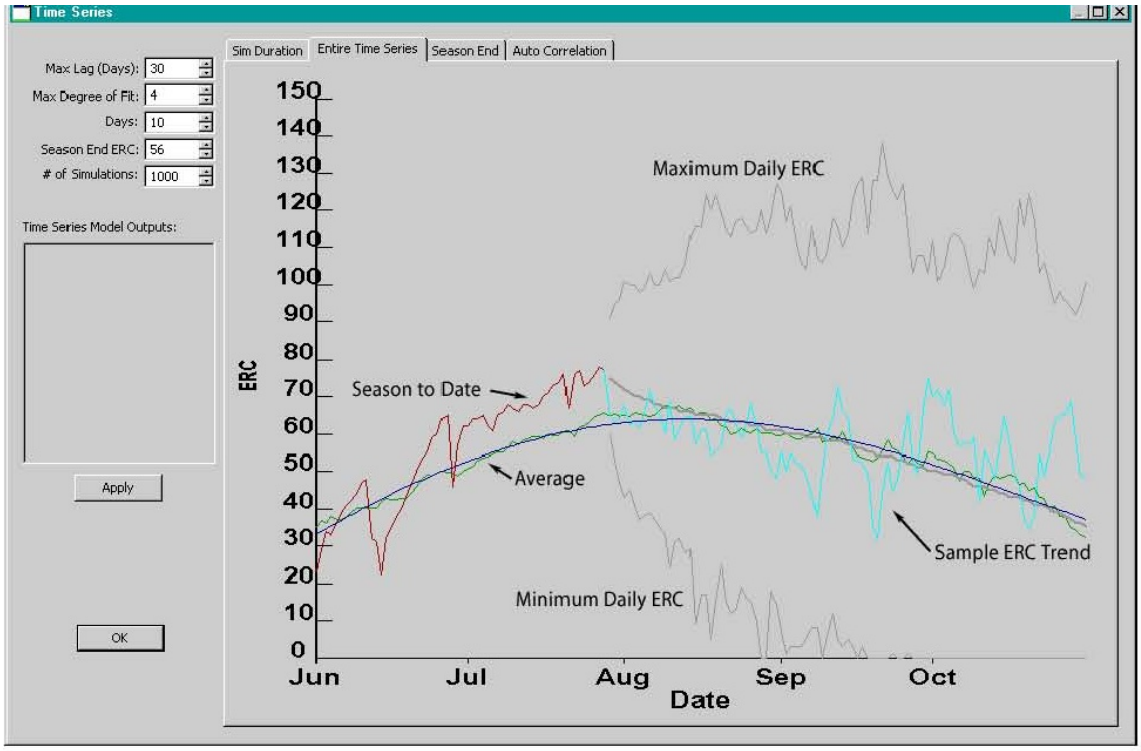

Wind Percentages
Calm Winds Percent: 0.8

Speed	Dir 1	Dir 2	Dir 3	Dir 4	Dir 5	Dir 6	Dir 7	Dir 8
	45.00	90.00	135.00	180.00	225.00	270.00	315.00	360.00
3	0.40	0.30	0.40	0.60	0.70	1.20	2.20	1.40
6	0.90	0.60	1.40	2.20	1.90	5.30	9.00	1.40
9	0.40	0.00	0.80	1.20	0.40	7.90	15.90	0.30
12	0.20	0.00	0.50	0.50	0.20	11.10	14.60	0.10
15	0.00	0.00	0.20	0.20	0.00	5.30	6.20	0.00

Add Row
Delete Row
Load

Each combination of ERC and wind speed/direction is a weather scenario. There are usually between 100 and 300 possible scenarios in an FSPro run. Each simulation picks a new weather scenario for each day based on the historic frequencies and the use of "time-series analysis" which accounts for the seasonal and daily trends in fuel moisture. Time-

series analysis allows the fuel moisture characteristics of the current year to be considered in the probabilities of fire movement and it estimates the probability of season end.



Winds and ERC are selected independently because of statistically poor correlations between daily winds and fuel moisture content (a cumulative value representing many days). Weather forecasts can be used to override the probabilistic weather scenario early in all simulations, usually one to three days and used for model calibration against observed fire growth patterns. The output probability predictions are ASCII (.asc) files which can be viewed as grid files on a landscape within Flammap, or brought into a GIS application. The model does best with an accurate fire perimeter and landscape file using a RAWS station representative of the fire area. The program has been developed to work with new multi core processors (16 dual core processors, with 32 processor machines available in 2007). The computations are complex and require higher end computers to perform the calculations. Estimated cost for the new 32 processor's is $50,000 each.

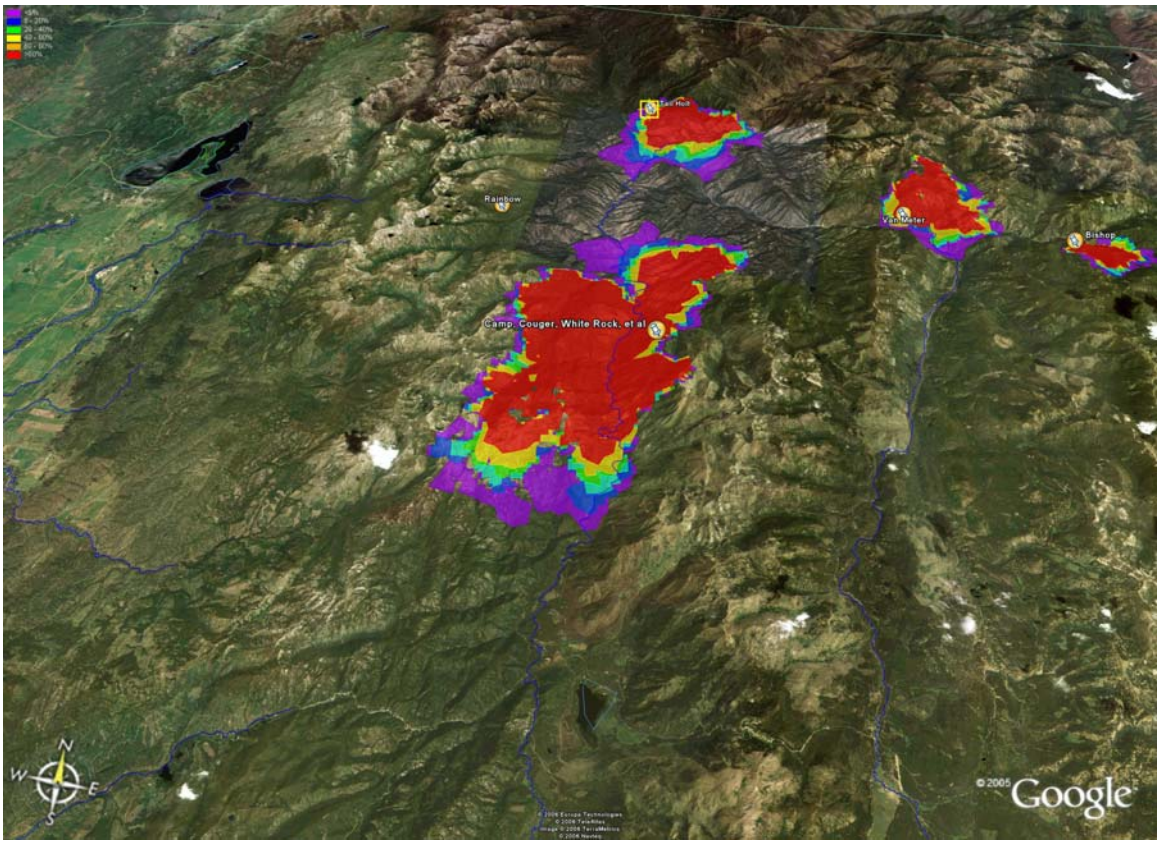


Figure 1 South Fork Complex - Payette NF