Seasonal Analysis of Large Fire Potential

Dollar Lake Fire

By

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Executive Summary

The Dollar Lake Fire will continue to retain heat within its perimeters until season-ending weather arrives and eliminates the possibility of escape. This document will discuss the mechanism of spread identified for the Dollar Lake Fire in comparison to the 2008 Gnarl Ridge Fire. Indicators of potential large fire growth are also displayed and discussed.

Introduction

The winter of 1010-11 was above normal for snowpack on Mount Hood. Spring was wet and cool. This delayed the start of fire season by several weeks.

Mount Hood presents a problem when analyzing weather data. The mountain clearly affects the environment. All of the variables associated with predicting fire behavior and fire danger are present. Elevations on the fire range from 3,000 feet to over 6,000 feet. All of the aspects are present. Winds are dominated by a southwesterly flow. The mountain also adds the potential for strong down slope winds. The steep and heavily dissected terrain contributes to wind channeling. Many drainages radiate out from Mount Hood.

Topography effects vegetation due to changes in elevation and aspect. These same characteristics affect fuel moistures. Terrain features, such as ridges, create micro-climates by impeding or channeling moisture into an area. The terrain in the Dollar Lake Fire is a good example of this affect.

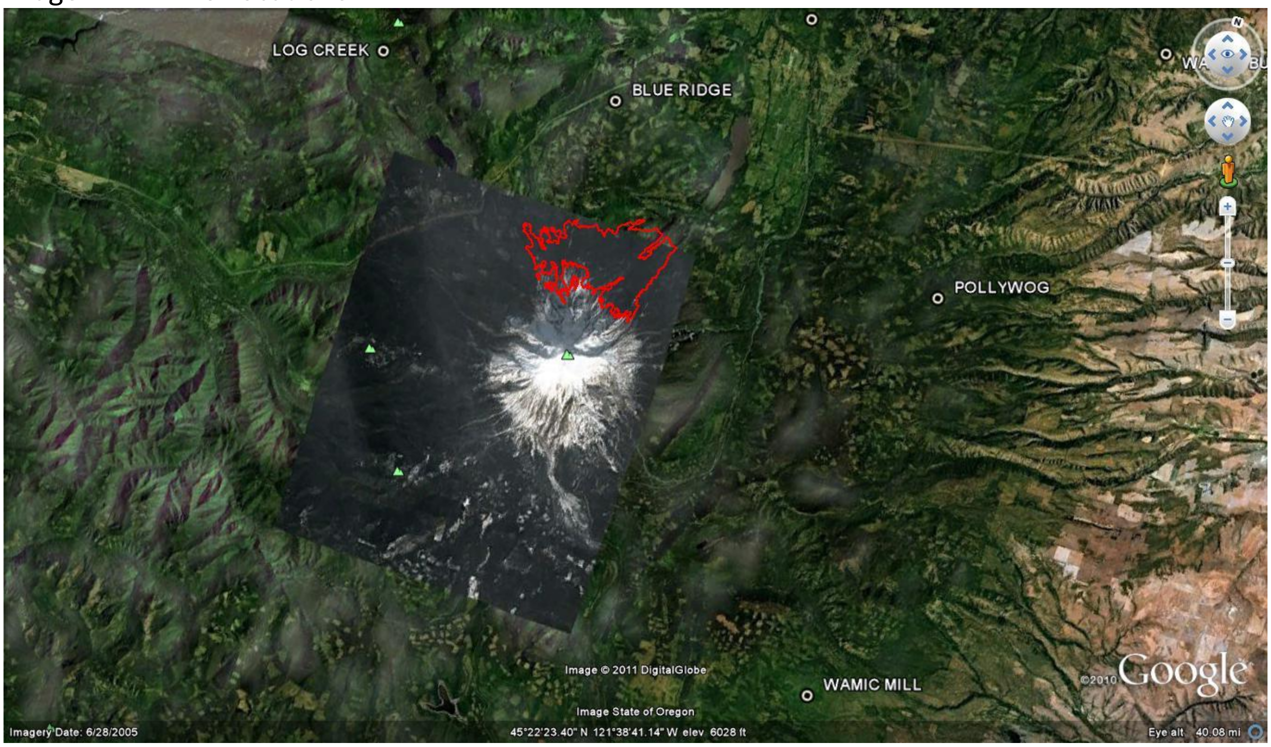
Fuels in the area are dominated by timber litter and under story (Fire Behavior Fuel Models 10 and 8). LANDFIRE displays model 10 as the predominant fuel model in the area. At lower elevations on the north edge of the fire harvesting has changed some of the model 10 to model 8.

Fire Growth Analysis

This analysis focuses on two fires. The Gnarl Ridge Fire (September 16, 2008) and the Dollar Lake Fire (August 26, 2011). The Gnarl Ridge Fire initiated a major run shortly after midnight on September 16, 2008. The Dollar Lake Fire made major runs on August 29, September 3rd and September 10th, 2011. An analysis of weather data collected at nearby Remote Automated Weather Stations (RAWS) was done to access the conditions recorded on the days the events occurred.

Two RAWS, Pollywog and Wamic Mill were selected to display the ERC values for the dates of significant fire spread on the Gnarl Ridge and Dollar Lake fires. Pollywog RAWS is located 10 miles ENE of both fires. Wamic RAWS is located 16 miles SE of both fires. Two other RAWS, Blue Ridge and Log Creek, were evaluated before these two stations were selected.

Image 1   RAWS Locations



There are several potential indicators that can be used to analyze fire danger trends. Precipitation amount and duration, National Fire Danger Rating System (NFDRS) Energy Release Component (ERC), Burning Index (BI) and Spread Component (SC) are the most commonly used. ERC was used in this analysis as it integrates many weather variables into a single adjective rating. It is an excellent index for overall fire danger and potential for large fire growth as it is based on fuel moistures, especially the larger fuels responsible for fire intensity.

Table 1 displays ERC values for each fire by run day.

Table 1   Observed ERCs by Fire Run Date   NFDRS Fuel Model G

RAWS	9/15/2008 Gnarl Ridge	9/16/2008 Gnarl Ridge	8/29/2011 Dollar Lake	9/3/2011 Dollar Lake	9/10/2011 Dollar Lake
Pollywog	72	73	64	63	78
Wamic Mill	73	74	77	75	86

Based on this analysis Table 2 displays Wamic Mill RAWs values for ERC's that exceed 70. This value was used as an indicator of large fire growth potential based on large fire growth associated with Gnarl Ridge and Dollar Lake fires. It is important to note that fire growth days often are not the day the fire starts. Often the ERC on a fire growth day is much higher than the day the fire was ignited.

Table 2 Wamic Mill ERC's greater than of 70.

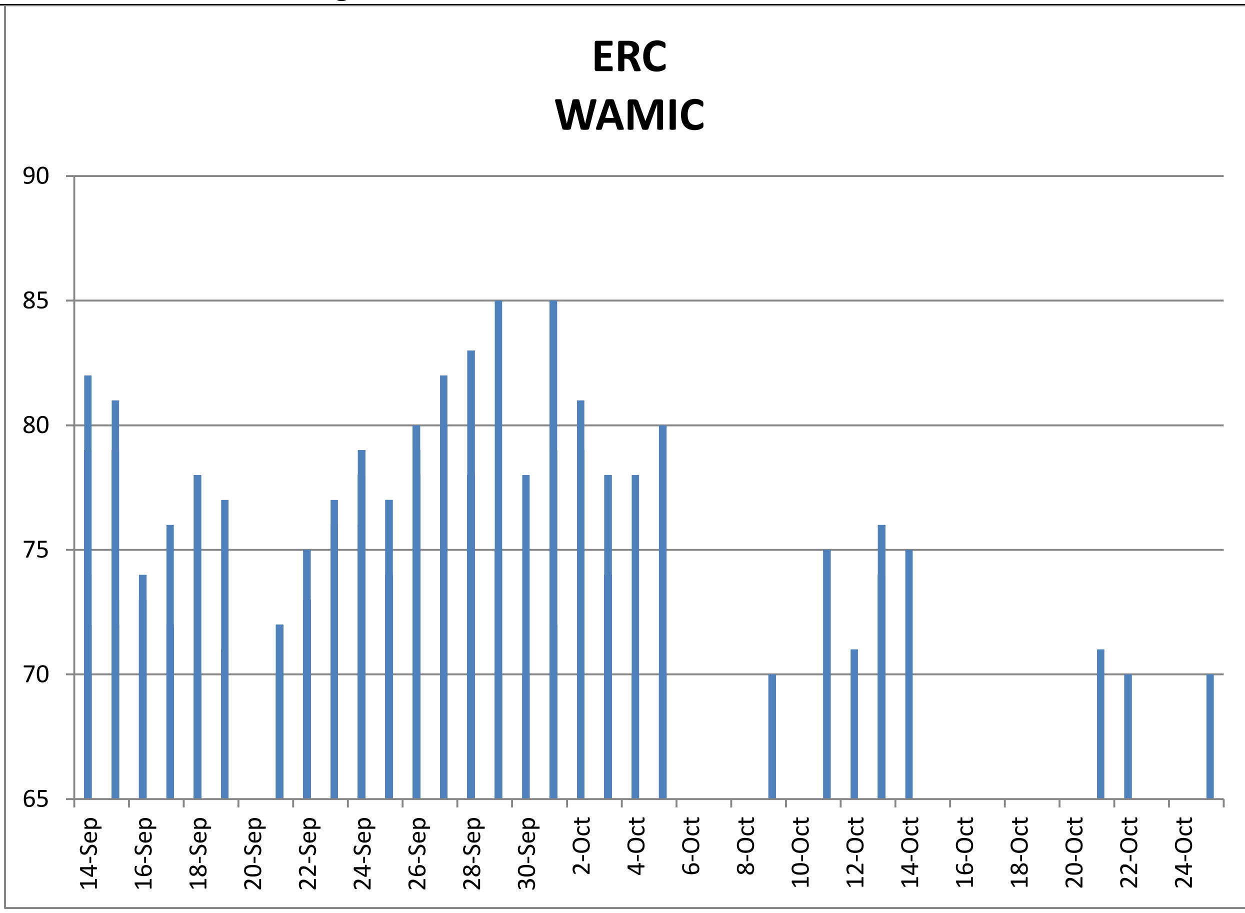
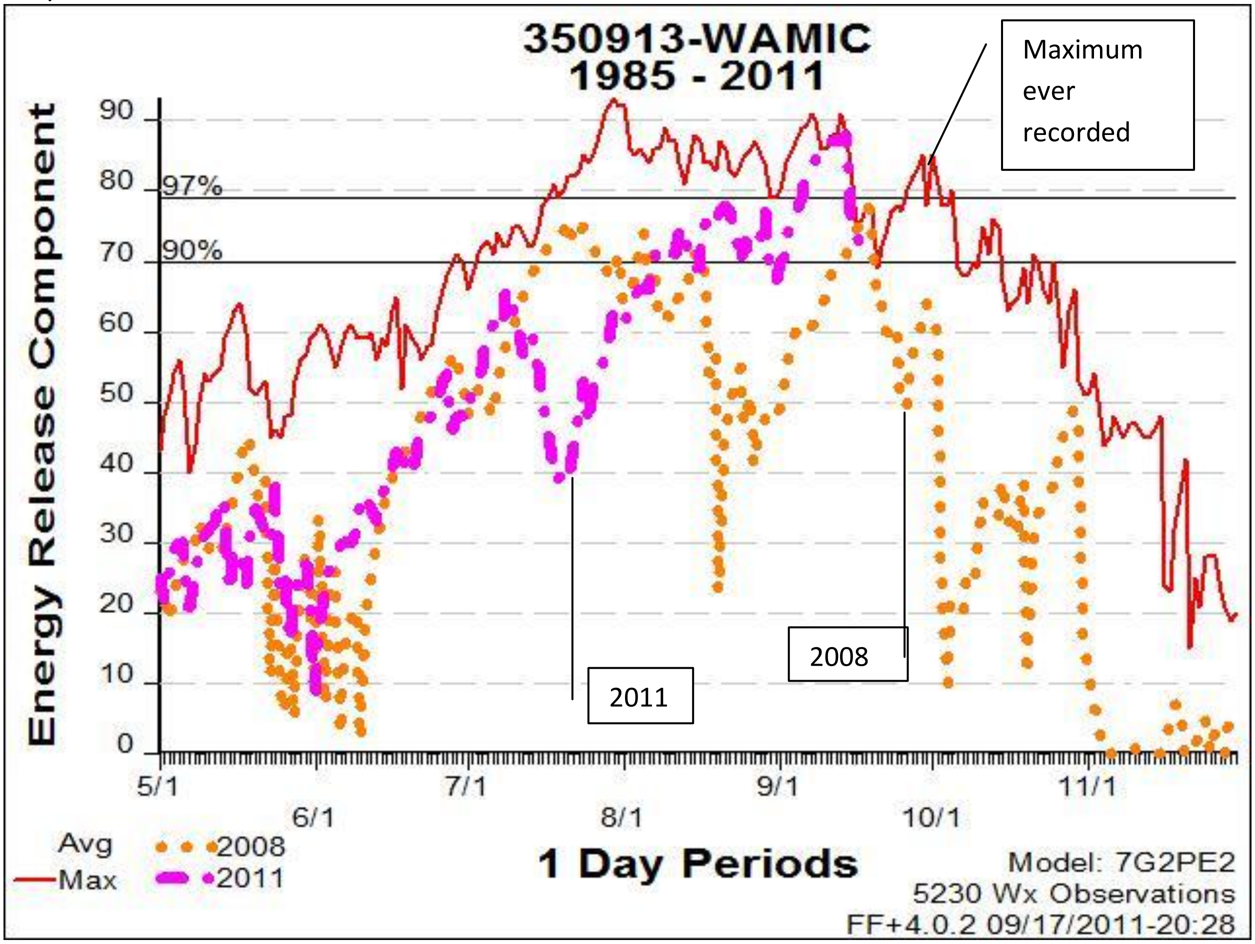


Table 2 indicates historically the number of days in the past 25 years (1985-2010) that ERC's have exceeded the 70 ERC threshold. Obviously high ERCs alone do not guarantee that large fires will occur. It takes an ignition source to be present as is the case of pre-existing smoldering fires in both Gnarl Ridge and Dollar Lake. Note that the frequency of threshold ERC's diminishes after early October.

Graph 1 ERC values for WAMIC RAWS 1985-2011



Graph 1 displays three traces of ERC for the Wamic RAWS. The solid red line represents the trace created by plotting the highest value for ERC recorded per day in the period May 1, 1985 through November 30, 2011. Any given value can be from any of the years in the data, e.g. the highest July 2nd ERC (67) was recorded in 2003. The dotted orange line is a trace of the daily values of ERC for the year 2008 (Gnarl Ridge Fire). The purple dash-dot line is a trace of the daily values for the year 2011 (Dollar Lake Fire).

Table 3 displays the ERCs dates for Pollywog RAWS from Mid September through November.

Table 3 Pollywog ERC values greater than 63

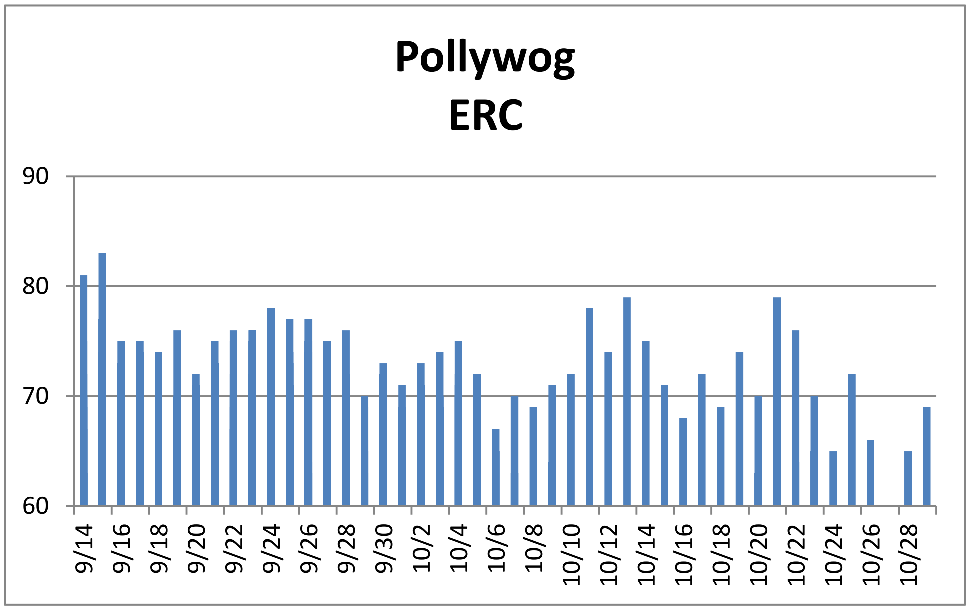
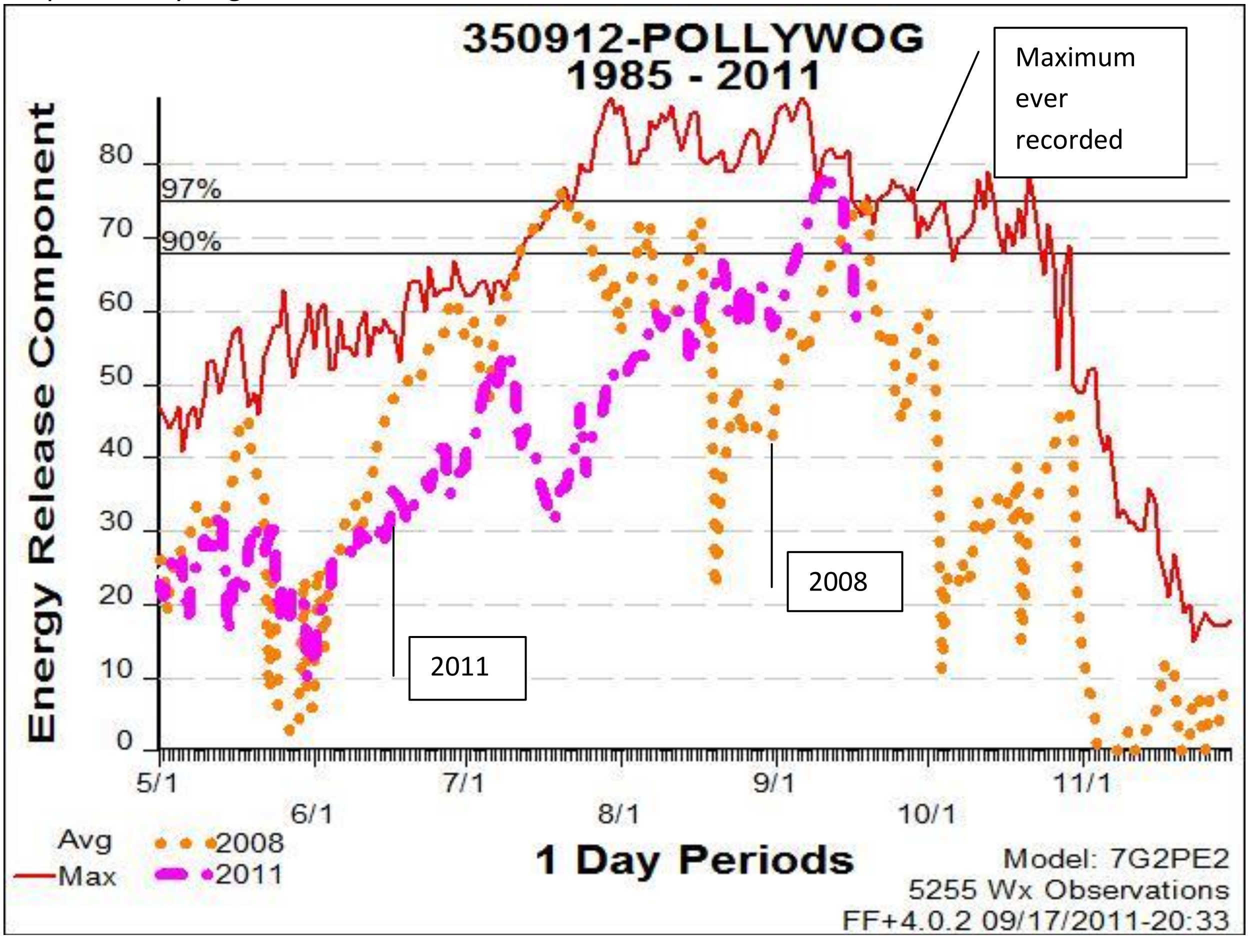


Table 3 displays ERC values for Pollywog RAWS that exceed 63. The threshold for large fire growth based on Gnarl Ridge and Dollar Lake is 63 as observed at the Pollywog RAWS. Note that based on 25 years of weather records the threshold days for large fire growth is steady until the end of October. This indicates the potential for the Dollar Lake fire to experience active growth before the end of the fire season. The chart does not mean that there is a continuous period when the ERCs are high it only implies that historically high ERCs have occurred on a given day in at least one year.

Graph 2   Pollywog ERC



Graph 2 shows the ERC traces for the Pollywog RAWS.

Both RAWS recorded very high ERC values during the Gnarl Ridge Fire spread, as displayed in Table 1. Little if any wind was recorded by RAWS after midnight when the fire was reported to have started its run. The fire likely spread through surface fuels with torching and spotting. Surface fuels burning initiated and maintained the crown fire (active crown fire).

The following images (2, 3 and 4) display the perimeter and intense heat infrared imagery (IR) for the fire. The imagery is based on IR flights made in the late evening/early morning. These three images capture the three crown fire (canopy-to-canopy) events observed on this fire. Discussion of the fire behavior characteristics follows the images.

Fire in timber fuels often spread most rapidly when it is burning through the canopy. There are basically three types of canopy fire. The first stage is referred to as torching or passive. In this case surface fire heats up the crown of a tree or group of trees, igniting the aerial fuels. Spotting often occurs as a result. In the second stage is active crown fire. In this case surface fire spreads under the canopy igniting the canopy as it moves along. The surface and aerial fires spread in unison. Again, spotting generally occurs. This is the most common form of crown or canopy fires. The third type is independent crown fire. In this case the canopy fire once started spreads independently of the surface fire. These fires drop embers that ignite the surface fuel that burns after the canopy fire has passed. Independent canopy or crown fire has been observed covering several hundred acres when the surface fuels are still covered by snow.

Image 2   8/30/11   Dollar Lake Fire perimeter and intense heat

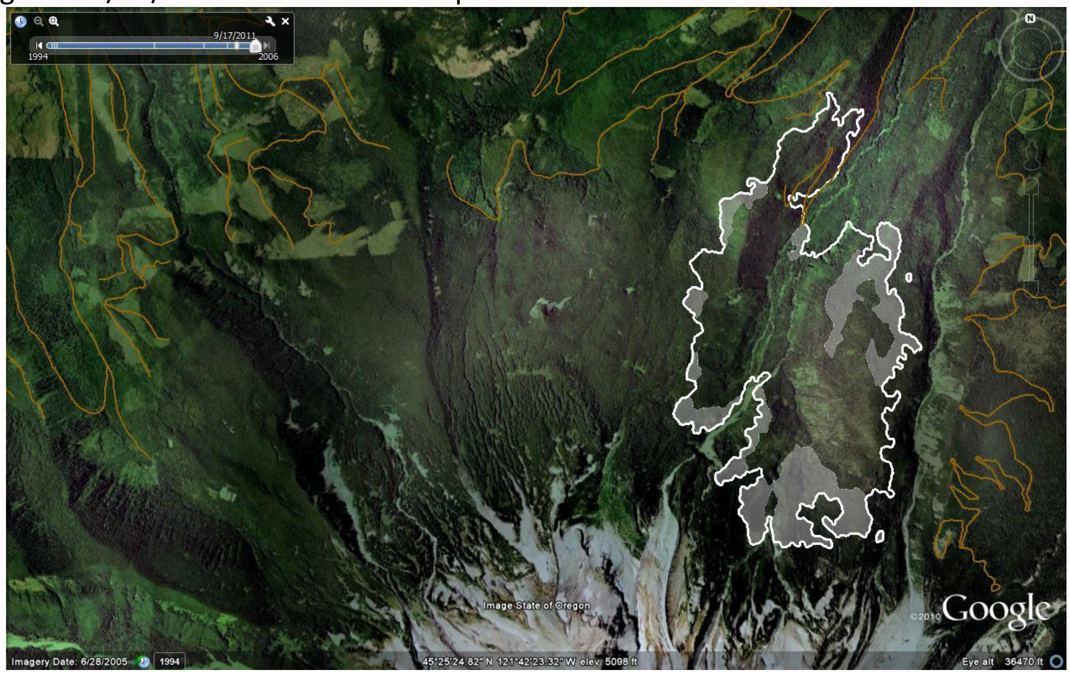


Image 3   9/03/11   Dollar Lake Fire perimeter and intense heat

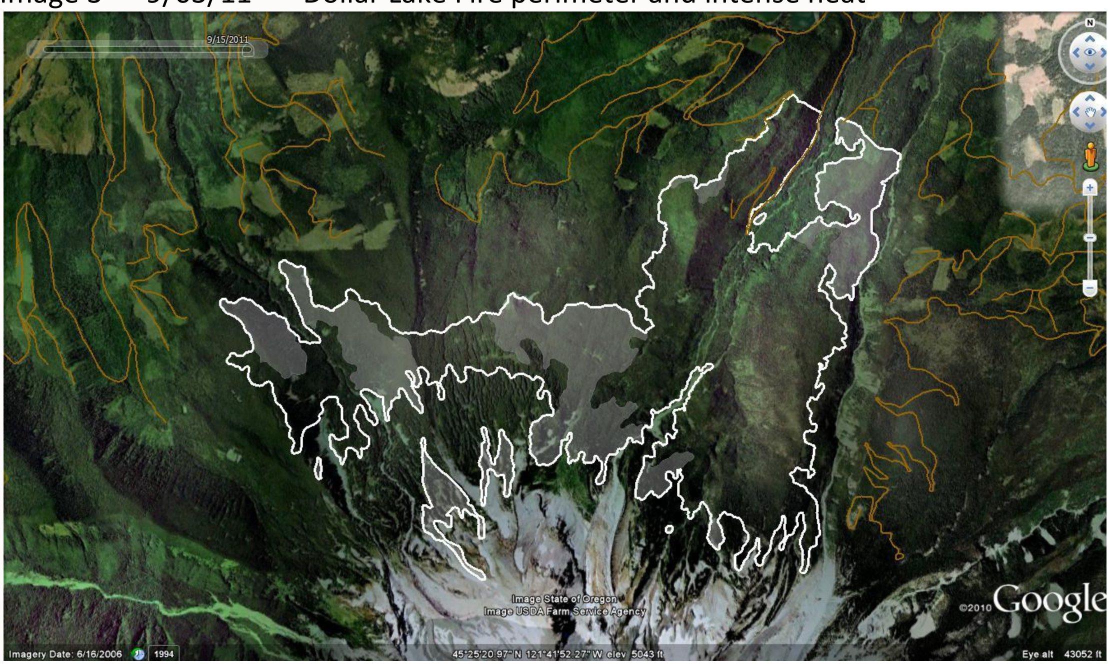
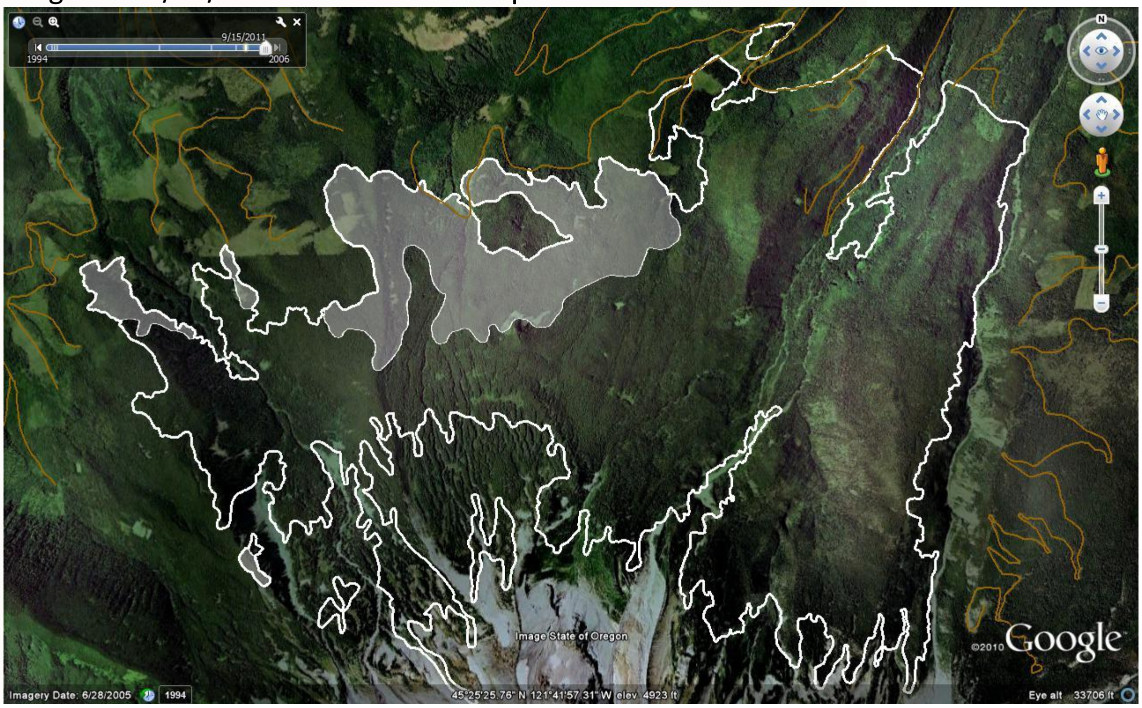


Image 4 9/10/11 Dollar Lake Fire perimeter and intense heat



The Dollar Lake fire made three independent crown runs. The primary carrier of the fire was lichen in the trees and on the boles. The lichen effectively lowers the live-to-dead ratio of the canopy fuels to a level that supports combustion of the entire canopy. Dry lichen supports crown fire much more readily than live canopy fuels alone. The canopy fuel runs on the Dollar Lake Fire were observed to lose momentum and cease when encountering terrain features, such as perpendicular ridges or down slope aspects. Canopy runs would continue as long as terrain aligned with the winds and canopy fuels were continuous.

Lichen is a very fine fuel (high surface area to volume ratio) and as a result reacts very rapidly to changes in the environment. It is estimated that it reacts in as little as 10 minutes. For example if the sun shines on the fuel it will heat up rapidly. Since it is very small in diameter it can be raised to ignition temperature very rapidly and release its heat during combustion quickly. As it burns it dries out live fuels in the crowns. When enough moisture is driven off of the crown fuels they will burn, contributing to fire intensity and spread. Pieces of burning lichen are prone to attach to other lichen on tree trunks and canopy foliage. This process exacerbates the spread of fire through the canopy fuels.

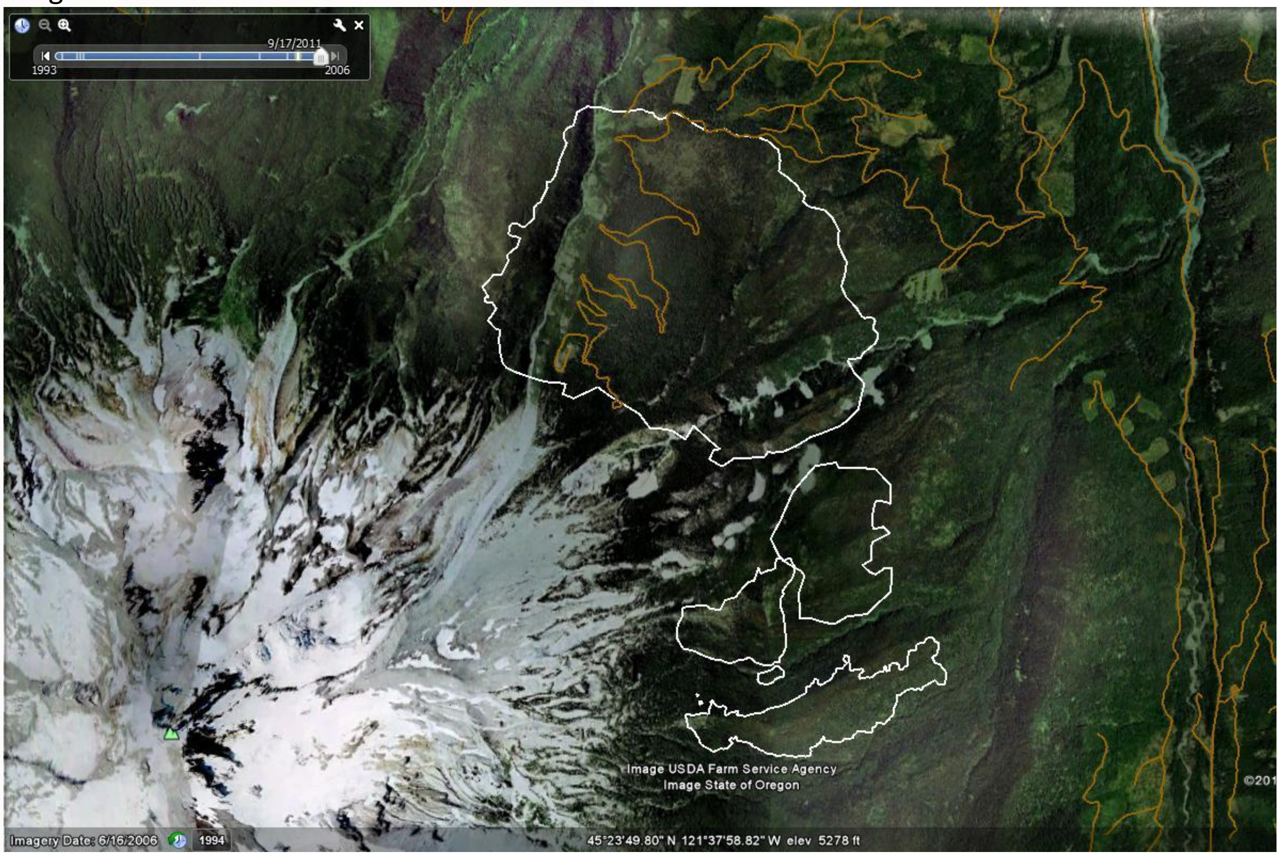
Images 5 and 6, below, were taken on 09/11/11 in Division A of the Dollar Lake Fire by Gene Rogers, FBAN. The first shows a heavy load of lichen on the trunks and foliage of the trees in the area. The second shows actual fire spread from canopy-to-canopy as the lichen ignites readily then creates the heat to consume the foliage of the tree. Pieces of the burning lichen fall away from the first tree and drift to downwind trees igniting trunks or canopy. Note the ignition in the tree at center right. Wind speed (eye-level) was very light (<2 mph) yet this spread, canopy spread plus spot fires, covered 2 chains in 5 minutes.

Image 5   Lichen draped old growth

Image 6   Fire spread in lichen

On September 3rd a crown fire spread event occurred that went roughly 3 miles. Observations of the surface fuels after the run showed that the surface fuel had not been consumed but only charred by the passing canopy heat. Conditions were extreme for the day with a Red Flag Warning for dry conditions and unstable conditions forecasted. Light east winds were occurring. The first run started at about 0900 hours and ran east to west for two miles along the northern edge of the current perimeter. Later runs were also east to west with a total of about 1,000 acres added to the fire size. The fire was active until 0300 hours on September 11th. The September 10 run also spread rapidly through the crowns but spots ignited the surface fuels. Spots continued to spread throughout the night and into the next day. One, ten and hundred hours fuels were consumed but spread rates were low.

Image 7 Gnarl Fire 2008 Final Fire Perimeter



The major difference in fire behavior between the Gnarl Ridge Fire and the Dollar Lake Fire appears to be how the surface fire and crown fire were related. In Dollar it was an independent crown fire while in Gnarl Ridge it appears that the crowns were either not involved or limited to torching or group torching and some active crown fire. Surface fire spread was the primary mechanism causing fire movement in the Gnarl Ridge Fire.

Spotting likely occurred on both fires but the ignition point was surface fuels in Gnarl Ridge and lichen in the canopy on Dollar Lake.

The potential for Dollar Lake to exhibit large fire growth would depend on continued drying of the surface fuels to drive surface fire spread (ERC >63). For crown fire spread to occur a strong east wind event (>10 mph) in alignment with terrain and continuous fuel, coupled with an unstable atmosphere (Haines 5 or 6) and low relative humidity (<35%) would be needed. This combination would create a potential for lichen carried crown fire to spread beyond containment lines. These are the factors that were in place during the three very active fire spread days on the Dollar Lake fire.

Below is discussion of the risk assessment associated with the growth potential for an escaped fire.

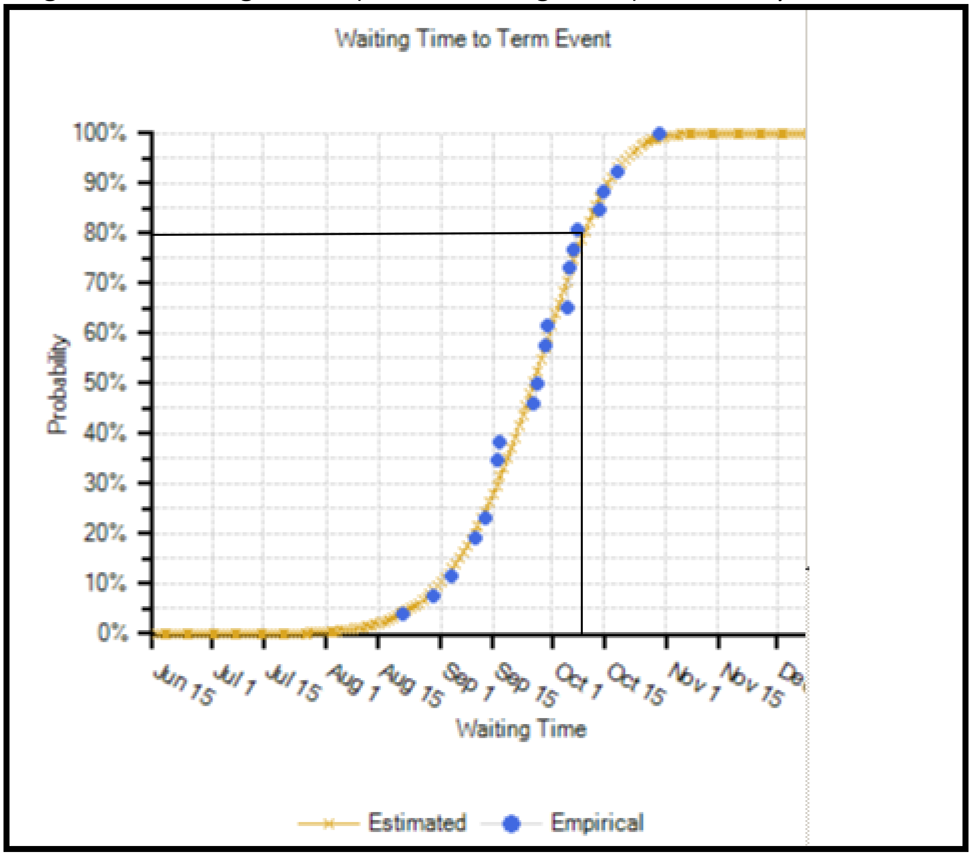
Long Term Risk Assessment

The Rare Event Risk Assessment Process (RERAP) uses statistical analysis to determine the chances that a fire will reach a specified point of concern before the season end. Weather data is extracted for specified time periods from a station considered representative of the weather on the fire using the percentile weather tool in Fire Family Plus. The potential path of the fire is described using fuel model, slope steepness, aspect, sheltering from the wind, shading from the sun, and so forth – the same environmental parameters used to adjust fuel moistures are used in calculating rate-of-spread. The same fire spread mathematical model used in BEHAVE is also used in RERAP to model surface fire spread. Other indicators of fire severity can be found in the National Fire Danger Rating System (NFDRS). Commonly either ERC or Spread Component (SC) is used in evaluating seasonal fire danger conditions. These parameters can also be used to determine the weather factors that drive fire danger and fire behavior. In this analysis ERC was used to define the season ending events. Spread Component was utilized to define weather parameters to estimate the percentile fuel moistures and wind speed used in RERAP.

Season Ending Events

The weather data for Log Creek, Blue Ridge, Pollywog, and Wamic Mill were extracted from National Interagency Fire Management Integrated Database and imported into Fire Family Plus. Also imported were all of the fires in the national database from 1970 to 2010 for the local districts of the Mount Hood National Forest. Using Fires Analysis in Fire Family Plus it was found that no fires greater than five acres occur when the ERC value was less than 32 at Log Creek, 34 at Blue Ridge and 48 at Pollywog. These ERC thresholds were used in developing the season ending event distribution (TERM) portion of RERAP. To accomplish this, RAWS weather records (1985-2010) were scanned to find the latest date that the threshold ERC was observed in each year. These dates are complied in RERAP and a TERM file is created that represents a probability distribution of the season ending event for each year. Figure 1 displays the TERM file for Blue Ridge RAWS.

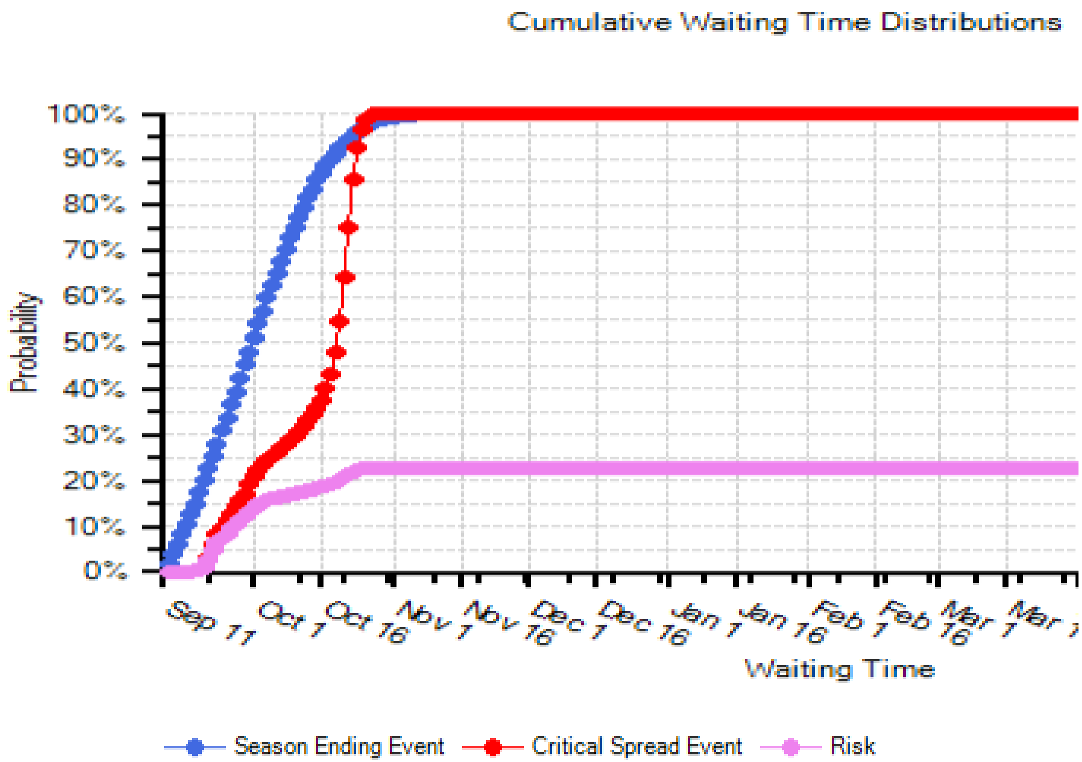
Figure 1 Blue Ridge Term (Season Ending Event) Probability Distribution



The appropriate TERM file was used for each RAWS Station. For example, for those RERAP runs to the north Blue Ridge RAWS weather was used to generate the wind and fuel moisture values for fire spread distance distribution and the Blue Ridge TERM file was used to used generate the season ending event distribution. In this graph the 80th percentile is about Oct 9th, meaning there is an 80% chance of the season ending weather event occurring by that date.

Figure 2 displays the RISK and TERM distributions for fire spread for Line C (from H3 to Road 1631, see Image 7)

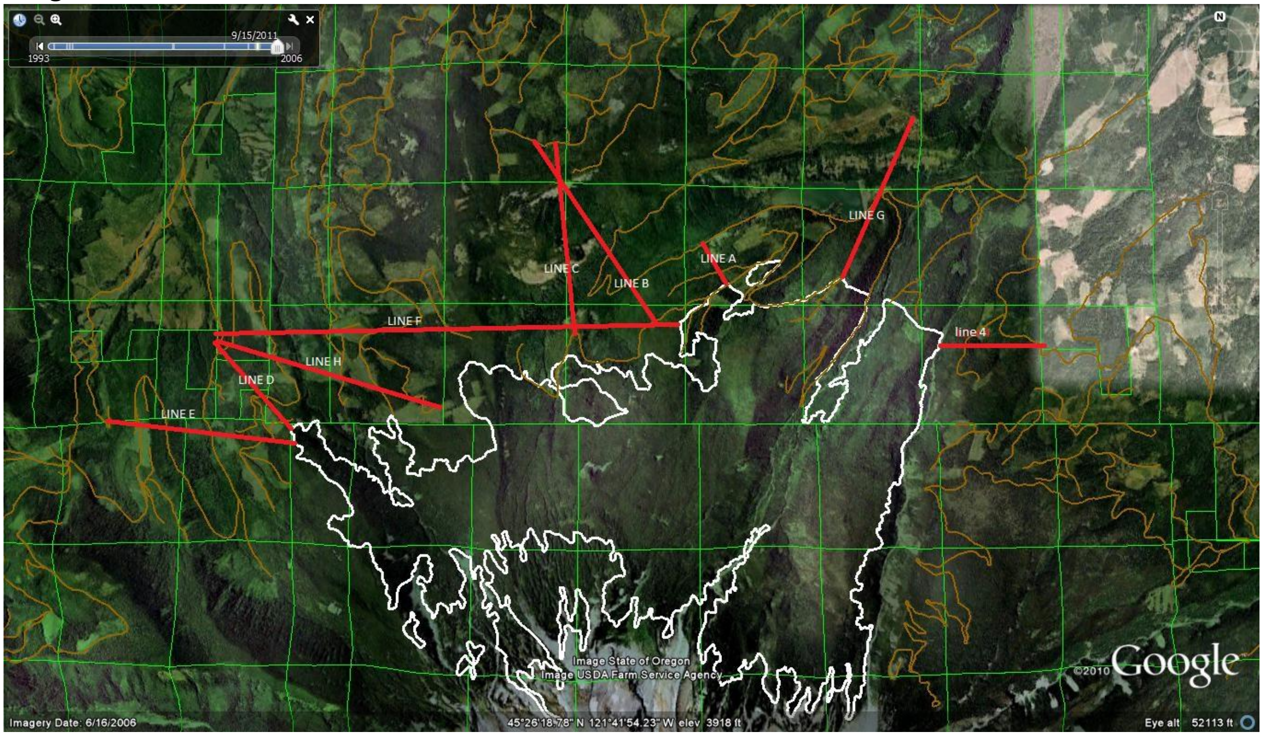
Figure 2 Line C Waiting Time Probability Distributions



The Waiting Time Probability Distributions graph displays the probability of an event occurring on a given day. For the fire manager, this graph shows the probability of fire spread arriving at the point of concern before a season ending event has occurred. Figure 2 displays that there is a 22% chance that the fire will spread along Line C from H3 to Road 1631 before the season ending weather event. The season ending event distribution is represented by the blue line in Figure 2. That line reaches 100% about November 1st as shown in both Figure 1 (TERM file) and Figure 2.

The risk of the event (fire reaching the Road 1631) increases until the season ending event has occurred (100% on the blue line, November 1st). In this case the risk line (pink) flattens out at 22%. Conversely, there is 78% chance that the season ending event will occur before the fire reaches the road.

Image 7   RERAP Lines Dollar Lake Fire



Nine RERAP lines were projected from the fire edge to points of concern (See Image 7 and Table 4). The areas of concern are based on objectives as defined in the Delegation of Authority and the Strategic Containment Plan developed 9/11/11. The RERAP projections represent fire spread toward areas of concern. The RERAP model estimates the fire spread distance that can take place before fall weather patterns essentially stop the spread of the fire (Season Ending Event).

Table 4   RERAP Line Dollar Lake Fire

Projection	Location	Distance	RISK of Fire Arrival
Line 4	East to private lands	65 chains	62%
Line A	DP 9 north to Road 641	84 chains	56%
Line B	Decommissioned road to 1631	184 chains	23%
Line C	H3 North to 1631	138 chains	22%
Line D	Ladd creek to private lands	92 chains	21%
Line E	Cathedral to Power line	133 chains	22%
Line F	Vista Ridge West to private land	184 chains	11%
Line G	Div break A/B to Road 640	126 chains	26%
Line H	DP 80 to Private Land	203 chains	7%

Fuel model information used in RERAP is based on fuel models from LANDFIRE coverage's and on site observations. The TERM file used was developed as described above on page 12 and 13 and displayed in Figure 1. RERAP results are based on the following assumptions:

- Fuels and data used are representative of the area
- No management actions are taken to slow or stop the spread
- All runs assume a spot fire occurs outside of containment lines

Spatial Differences

The following comparison of RAWS variables demonstrates the results of a comparison of RAWS data west and east of the Dollar Lake Fire. Data covered September 12 - November 31, 1985-2010.

Table 5 West side/East side Fire Weather Comparison

Variable	Log Creek RAWS	Variable	Pollywog RAWS
Zero Precipitation	46%	Zero Precipitation	66%
One Hr Fuel Moisture < 25%	37%	One Hr Fuel Moisture < 25%	20%
Energy Release Component > 32	8%	Energy Release Component > 48	25%
Minimum RH < 35%	20%	Minimum RH < 35%	39%

Precipitation, chances of a dry day: Generally large fire spread is greatly curtailed by precipitation.

One hour fuel moisture: The moisture content of extinction is 25% for timber litter (model 10). At this value spread is nonexistent or sporadic.

Energy Release Component (ERC): Data for fires on Barlow, Hood River and Columbia Gorge RD indicate a threshold for a fire (five acres of larger) is at least 48 at Pollywog and 32 at Log Creek.

Minimum Relative Humidity: Based on observations of fire behavior on this fire. Spread in the crowns is greatly reduced when the RH is greater than 35%.

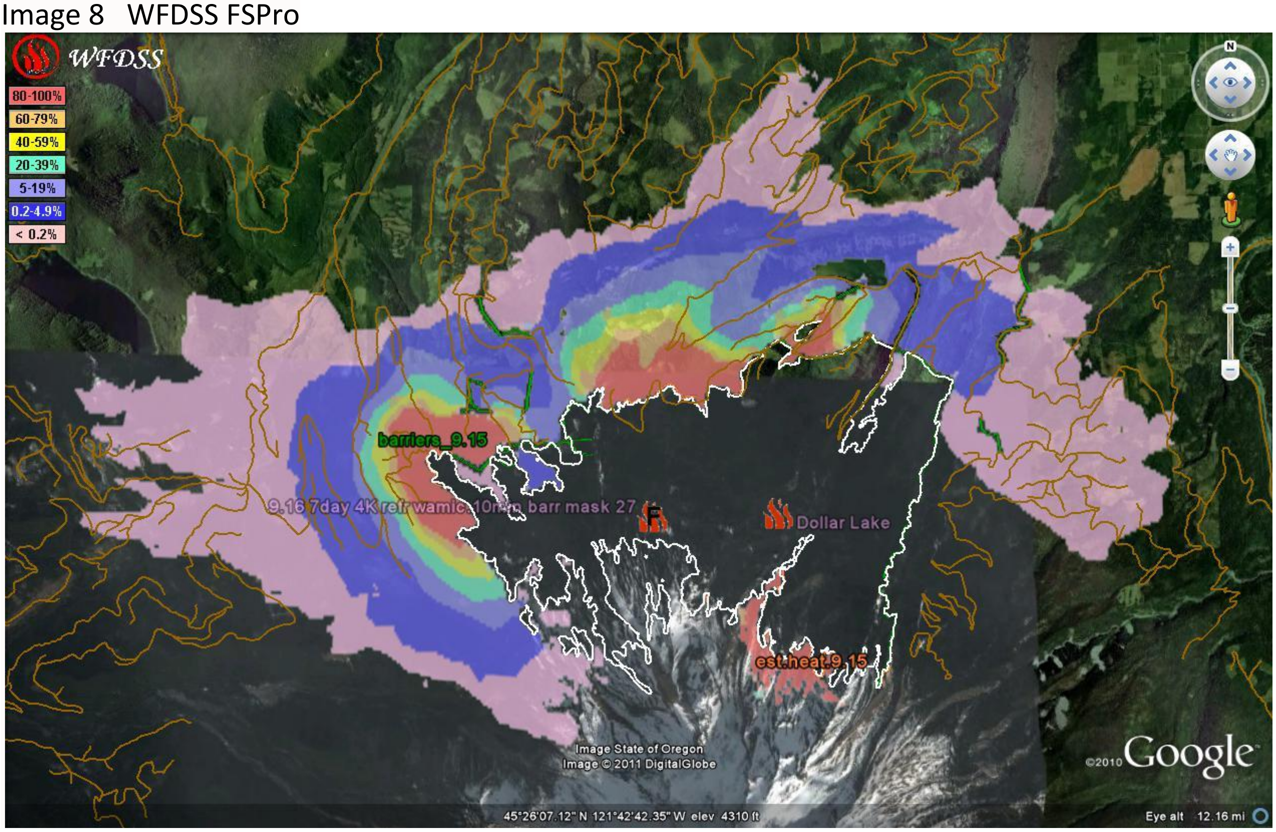
This analysis indicates that the chances of having "critical event days" from September 12 through November 31 is much less at Log Creek than it is at Pollywog. Generally the probability of an event occurring is 20% less at Log Creek.

WFDSS-FSPro.

FSPro (Fire Spread Probability) is a spatial model that calculates the probability of fire spread from a current fire perimeter or ignition point for a specified time period. Inputs to the application are similar to the established FARSITE application, surface fuel model, aspect, elevation, slope, and canopy characteristics. These landscape characteristics are used in conjunction with historical ERC and wind data from a representative remote automated weather station (RAWS) as key model inputs. WFDSS-FSPro through the use of high end computers can calculate fire spread probabilities out into the future. Projections can range from7 days to 90 days. The current "normal" projection is for a 10 – 14 day period.

Image 5 shows the outputs of the Dollar Lake Fire simulation in FSPro. The color bands in the image are zones of probability of an acre burning, not a projected fire perimeter. For example, the red band indicates a zone where the probability of fire spread is 80-100%. The zone of spread to the west is an east wind simulation, the zone of spread to the east is a west wind simulation. The settings and discussion from the analyst are below the image.

Image 8 WFDSS FSPro

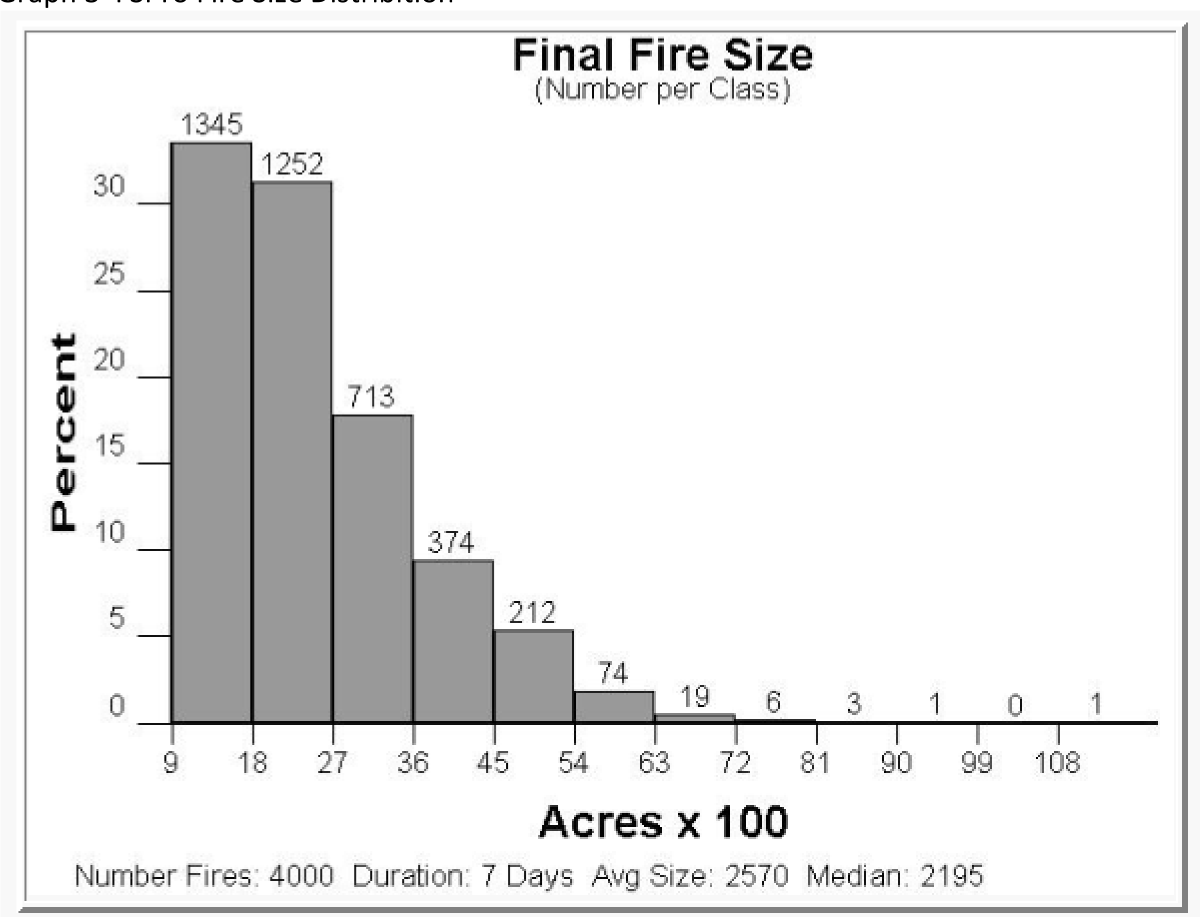


This FSPro simulation was done by Rich Stratton, Fire Analyst, USFS Regional Office in Portland.

SETTINGS: This simulation incorporates ALL control lines (dozer, hand, & cold black/natural barriers) as well as the recent burn. Ignitions were based on the Sept 14 and 16 IR. Any heat near containment lines or the cold black was imported as an ignition and placed exterior to the containment lines to simulate a breach in the fireline. Also, included are several days of forecast to capture the cooler temps and SW winds.

DISCUSSION: This simulation is very different than any previous FSPro runs. It is mostly hypothetical--that is, of the remaining heat on the fire, if it reignites or spots over the line what is the probability of spread given cooler temps and higher RHs, firelines, and recently burned areas? Risk is negligible to the south due to Mt. Hood and to the north due to a lack of wind in the forecast (a SW flow). The most likely fire movement is to the east or west, albeit a low probability.

Graph 3 FSPro Fire Size Distribition



Graph 3 shows the final fire size distribution for the 4000 fires simulated by FSPro. The size distributions are based on no suppression and 7 days of continued fire spread. This chart displays the acres burned and is not a probability distribution.

Conclusion

The potential for a fire to escape the current perimeter of the Dollar Lake Fire has been identified by reviewing the conditions for three major fire run events plus information collected regarding the growth of the nearby Gnarl Ridge Fire in 2008. Fire activity within the Dollar Lake Fire perimeter and fire growth potential outside the perimeter will be possible when the ERC is 32 or greater as observed at the Log Creek RAWS and/or 48 at the Pollywog RAWS. This potential will be increased if forecasted winds are out of the east at greater than 10 mph, the RH is less than 35% and the wind, slope and fuels are in alignment. ERC's greater than 63 have had a strong influence on large fire growth capable of easily exceeding containment lines and suppression efforts. RERAP and FSPro were used to predict fire spread and probabilities should the fire escape the current perimeter.

Although a season ending event is forecasted to occur by the end of October, it is far more important to track ERC and forecasted weather to prepare for potential fire growth.

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Dollar Lake Fire
9/17/11