Fire Surveillance and Early Event Detection

October 24 - 27, 2016
Kelowna, British Columbia

by
Cordy Tymstra
Presentation Outline

• Wildfire in Canada and Alberta
• Alberta’s preparedness approach
• Firesurveillance concept
• Process control concept
• Thresholds and “Unheard-ofs”
• Firesurveillance examples
Approximately 50% of wildfires are caused by lightning, but they account for about 80% of the total area burned.

“The four critical weather elements common to wildland fires exhibiting extreme fire behavior are low relative humidity, strong surface wind, unstable air, and drought.”

Mike Flannigan (Advanced Fire Weather Course, University of Alberta, March 16, 2016)

“A few critical days are responsible for most of the area burned”

“A few critical fires are responsible for most of the area burned”
Alberta’s Preparedness Approach
Wildland Fire Danger Rating and Early Warning Systems

Canadian Forest Fire Danger Rating System (CFFDRS)
Firesurveillance

Firesurveillance is the system level, integrated application of statistical visualization techniques to manage wildfire and wildfire environment data and information, for early warning, rapid detection and characterization of potential threats from wildfire events, and overall situational analysis (adapted from Fricker 2013)
Code Red

The highest state of wildfire management readiness based on current and/or forecasted wildfire potential to catastrophically impact human life and communities (Cory Davis, WMB).

Note: Catastrophic wildfire behavior may render the response capacity ineffective despite the availability and level of resources.
Challenges

• Starting Drought Codes
  ➢ No calibration
  ➢ Carry-over fraction of last fall’s moisture
  ➢ Effectiveness of winter precipitation in recharging moisture reserves in spring

• Spring dip

• Snow pack deterioration

Biosurveillance

Detection of biological threats

• **Security threats (bioterrosim)**

• **Public health threats (disease outbreaks)**

• **Food and agriculture threats**
May 15, 2001 – 114 wildfires
May 11 – 15, 2011
22 on-going fires + 189 new starts = 211 fires

53 new fires in Lesser Slave Area May 14 – 15, 2011
(all except 2 were human-caused fires)
### Weather Stations

<table>
<thead>
<tr>
<th>Station</th>
<th>Index Name</th>
<th>100 Percentile</th>
<th>Wind Direction %</th>
<th>Maximum</th>
<th>Data Found</th>
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<td></td>
<td></td>
<td></td>
<td>Start Date</td>
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<td># Records</td>
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<td>Total Days</td>
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<thead>
<tr>
<th>Station</th>
<th>Index Name</th>
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<th>Occur Date</th>
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<td>L3</td>
<td>FFMC</td>
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<td>1996/05/17</td>
<td>1,364 33.28%</td>
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<tr>
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<td>1,364 33.28%</td>
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<tr>
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<tr>
<td>L3</td>
<td>FWI</td>
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<td>41.60</td>
<td>2015/05/25</td>
<td>1996/05/17</td>
<td>1,364 33.28%</td>
</tr>
</tbody>
</table>
May IA Escapes

Number of IA Failures vs. Day

- The graph shows the number of IA escapes for each day in May.
- There is a noticeable increase in the number of escapes towards the end of the month.
- The x-axis represents the day of the month, ranging from 1 to 31.
- The y-axis represents the number of IA failures, ranging from 0 to 20.
xbar Chart
for escapes[1:31,]

Group summary statistics

Number of groups = 31
Center = 0.8027295
StdDev = 1.697531

LCL = -0.1960099
UCL = 1.801469

Number beyond limits = 0
Number violating runs = 0
Shewart Control Charts

- No changes UCL = 1.8
- Removed zeros UCL = 6.25
- 99\textsuperscript{th} Percentile UCL = 9.0
- Estimate Poisson Lamda
- Remove out of control observations
- Maximum Likelihood Estimates of Lamda (ZIP)

Cumulative moving average, weighted moving average, exponential moving average, conditional average

8 IA escapes in one or two consecutive days:
2-Day rolling sum
c Chart for Year 2016

Number of groups = 31
Center = 0.8027295
StdDev = 0.8959517
LCL = 0
UCL = 8
Number beyond limits = 12
Number violating runs = 74
“Unheard-ofs”

Unlikely
Far-fetched
Implausible
Unbelievable

One-off
Exceptional
Preposterous

Not expected
Outside chance
Hundred-to-one
Rare
Slim and none

Shocking
Inconceivable
Unheard-ofs

Feb. 10, 2016 6:02 pm
email from Morgan Kehr, Director, Wildfire Operations
“The grouse are feeding in the tops of our aspen trees tonight. Much earlier than last year. Buds are swollen.”

Feb. 23, 2016 10:30 am
Wildfire CWF-209 near Chain Lakes Provincial Park in southern Alberta requires bucketing support.

Feb. 27, 2016 11:00 am
The Fat Franks vendor guy starts selling smokies and hot dogs in front of our office
Contributing critical factors in spring

- \( \geq \) Two consecutive days of extremely low RH (< 20%)
- Occurrence of April holdover wildfires
- Arctic high and associated strong desiccating SE Winds (direct attack at head not possible when winds > 25 km/h)
- Low level jets
- Winds > 65 – 70 km/h (aerial suppression not possible)
- Sustained desiccating winds (very strong, very dry)
- Frontal passages
- Oceanic Nino Index
### May 1990 – 2015

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Escape</th>
<th>Success</th>
<th>Size</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Wildfire Arrival</td>
<td>7,523</td>
<td>890,336,30</td>
<td>97%</td>
<td>6,698</td>
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<tr>
<td>IA Success</td>
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<td>914,395,85</td>
<td>91%</td>
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<tr>
<td>IA Escape</td>
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<td>9%</td>
<td>644</td>
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<tr>
<td>BH Success</td>
<td>31%</td>
<td>028,180,25</td>
<td>31%</td>
<td>212</td>
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<tr>
<td>BH Escape</td>
<td>3%</td>
<td>024,458,33</td>
<td>3%</td>
<td>181</td>
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<td>&gt; 200 ha</td>
<td>14,963</td>
<td>001,196,33</td>
<td>14%</td>
<td>9</td>
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<td>&lt;= 200 ha</td>
<td>998,7%</td>
<td>889,139,97</td>
<td>99%</td>
<td>6,689</td>
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<td>005,405,41</td>
<td>37%</td>
<td>78</td>
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<td>&lt;= 200 ha</td>
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<td>058,605,97</td>
<td>99%</td>
<td>418</td>
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<td>&gt; 200 ha</td>
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<td>010,368,20</td>
<td>63%</td>
<td>134</td>
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<td>&lt;= 200 ha</td>
<td>999%</td>
<td>017,812,04</td>
<td>99%</td>
<td>134</td>
</tr>
</tbody>
</table>
Spring Arctic Blocking High
A fire weather advisory is issued for all active boreal fire zones and extreme BUI areas effective 1200 Thur Jul 02 to 0600 Sat Jul 04 due to a cold front passage. Caution advised in all fire operations.

Summary: Unstable conditions continue in the eastern boreal areas this burning period while boreal zones west of the fifth are generally more stable as the upper ridge begins to temporarily rebuild over western Alberta. RH values will trend lower in most areas Thur as temperatures increase into the 26-30 deg range. Brisk SW winds are expected to develop over the NW boreal region Thurs aften ahead of a Pacific low pressure system moving into the southern Yukon by late afternoon. Very easy burning conditions are expected in the CJI/FV zone Thurs. The low pressure system will push a cold front into the CJI zone by mid evening Thur. Gusty W-NW winds are expected behind the front as it drives eastward overnight into the central boreal zones. Strong NW winds of 30-50 km/h are expected in the CJI/MA/FV zones by Fri morning generating extreme ISI values at some stns. The gusty NW winds will spread eastward with the front during the aften. A risk of scattered TRW RW will accompany the frontal passage.

Outlook for Friday: Cold front pushes eastward across boreal regions with strong W-NW winds. Extreme ISI values in some boreal areas. Temps falling behind front into the 20-23 deg range with higher risk of TRW RW along the front in eastern boreal zones. Higher temps in 26-29 deg range ahead of front.

Outlook for Saturday: Cool and humid conditions all areas as upper trough drives southwards through the province. Extensive cloud and widespread showers/rain. Max temps in 17-20 deg range with N-NW winds of 15-20 km/h.
Questions