Mapping
Wildland Fire Potential
for the
Conterminous United States

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Jim Menakis
Fire Modeling Institute
Missoula Fire Science Laboratory
Rocky Mountain Research Station
Missoula, MT
Increased Acres Burned by Wildfires

Acres Burned by Year for the 11 Western States

Departure from Historical Fire Behavior
- Increased Severity
- Less Frequent

Chart showing bar graph with years on the x-axis (1916 to 2005) and millions on the y-axis.
Shifting Demographics

- More People are Moving into the Wildland Interface…
- With little Understanding of their Environment…
- And…
- Sometimes resulting in Catastrophic Consequences…

Hi Meadow Fire (2000): Pine Valley, Colorado
Photo by Andrea Booher/FEMA News Photo
# Recent Fire Seasons

**Entire U.S.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Acres (million)</th>
<th>Cost (billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>8.5</td>
<td>$1.3</td>
</tr>
<tr>
<td>2001</td>
<td>3.5</td>
<td>$0.918</td>
</tr>
<tr>
<td>2002</td>
<td>7.0</td>
<td>$1.6</td>
</tr>
<tr>
<td>2003</td>
<td>5.0</td>
<td>$1.3</td>
</tr>
<tr>
<td>2004*</td>
<td>7.7</td>
<td>$??</td>
</tr>
</tbody>
</table>

*as of Sept 29, 2004
A cohesive strategy is needed to address catastrophic wildland fire threats (W. U.S.) (GAO/RCED-99-65)

Federal agencies not organized to effectively and efficiently implement the National Fire Plan (GAO-01-1022T)

Improved planning will help agencies better identify fire fighting preparedness needs (GAO-02-158)

Reducing the threat of wildland fires requires sustained and coordinated effort (GAO-02-843)

Leadership and accountability needed to reduce risks to communities and resources (GAO-02-259)

Additional actions required to better identify and prioritize lands needing fuels reduction (GAO-03-805)

Technologies hold promise for wildland fire management, but challenges remain (GAO-03-1047)

Wildland Fires: FS & BLM need better information & a systematic approach for assessing the risk of environmental effects (GAO-04-705)

Geospatial Information: Better coordination needed to identify and reduce duplicative investments (GAO-04-703)
Fire Risk Map – Possible?

What The Client Wanted

What's needed to map Risk?
Fire Risk Map – Possible?
What The Client Wanted

What’s needed to map Risk?

Threat
Hazard
Value
Probability
Fire Risk Map – Possible?
What The Client Wanted

What's needed to map Risk?

Potential
Probability
Value

Threat
Map Wildland Fire Potential

Objective/Constraints

• Quickly
• Conterminous for the United States
• All Lands
  • Forest, Shrubs, and Grass
• Use Existing Data Products
• Temporary Product until LANDFIRE is available
Data Supports – National Level
Wildland Fire Potential

- **Fuel Budget Allocation Process**
  (Ecosystem Management Decision Support system)
  - Forest Service
    - Prioritize by Region and Forests
  - Department of Interior
    - BIA, BLM, FWS, NPS
    - Prioritize by Agency and Region

- **USFS State & Private Forest Redesign**
  (Spatial Assessment Model – Web based)
  - Prioritize by National, Regional, & State
General Inputs

Wildland Fire Potential

Fuel Potential

Weather Potential

Ignition Potential

Threat

Probability
General Inputs

Wildland Fire Potential

Fuel Potential

Surface Fire

Rate Of Spread

Flame Length
Surface Fire Potentials

Description:
Surface fire behavior under extreme weather conditions

Base Data:
Fuels Characteristic Classification System (FCCS) – Version 1.2
- Classification of complete fuelbed
- Classifies each stratum
  - Canopy, Shrub, Duff, etc.
- Modeling of fire characteristics
- Pacific Northwest Research Station, USFS

Processing:
Model run under very dry conditions
Predicted Surface Fire Rate of Spread

Based FCCs version 1.2

Legend
- 0 - 2.47
- 2.48 - 4.9
- 4.91 - 7.73
- 7.74 - 12.46
- 12.47 - 62.59

June 29, 2007
Surface Fire Potential

\[
\left(\frac{\text{Rate of Spread}^* + \text{Flame Length}^*}{2}\right) = \text{Surface Fuel Potential}
\]

*Quintile – five classes w/ each containing 1/5 the total population
Surface Fire Potential

Based on Surface Fire Predicted Rate of Spread and Flame Lengths

Legend
- Very Low
- Low
- Moderate
- High
- Very High

June 29, 2007
General Inputs

Wildland Fire Potential

Fuel Potential

Surface Fire

Crown Fire

Rate Of Spread

Flame Length
Crown Fire Potentials

Description:
Crown fire behavior under extreme weather conditions (Intensity, Speed, & Fire Brands)

Base Data:
Forests: FIA Forest Cover Types
  • MODIS satellite
  • FIA & RSAC
Range: Coarse Scale Cover Types
  • AVHRR satellite
  • Missoula Fire Science Lab, RMRS

Processing:
Relative assignments to cover type layers by fire behavior expert
General Inputs

Wildland Fire Potential

Fuel Potential

Surface Fire

Crown Fire

Rate Of Spread

Flame Length
Fuel Potential

Surface Fuels Potential
Based on Surface Fire Predicted Rate of Spread and Flame Lengths

Crown Fire Potential
Classes assigned to FIA Forest Types and Coarse Scale Vegetation Types

Legend
- Very Low
- Low
- Moderate
- High
- Very High

June 29, 2007

Fuels Potential
Based on Crown Fire Potential and Surface Fire Predicted Rate of Spread and Flame Lengths

Legend
- Very Low
- Low
- Moderate
- High
- Very High

June 29, 2007

\[
\left( \frac{\text{Surface Fire Potential} + \text{Crown Fire Potential}}{2} \right) = \text{Fuel Potential}
\]
Fuel Potential

Based on Crown Fire Potential and Surface Fire Predicted Rate of Spread and Flame Lengths

Legend
- Very Low
- Low
- Moderate
- High
- Very High

June 29, 2007
General Inputs

Wildland Fire Potential

Fuel Potential
- Surface Fire
  - Rate Of Spread
- Crown Fire
  - Flame Length

Weather Potential

Energy Release Component
Relative Energy Release Component

Description:
Average Number of Days per Year Relative Energy Release Component (ERC) is above 95%

Base Data:
Daily Average Relative ERC
• 1980 - 2005
• Derived from Weather Stations
• Interpolated using terrain correction
• Missoula Fire Science Lab, RMRS

Processing:
• Select Relative ERC > 95%
• Count the number of days
Average Number of Days per Year
Relative ERC > 95%

Legend
- Blue: 0 - 6
- Light Blue: 6.01 - 10
- Light Green: 10.01 - 16
- Yellow: 16.01 - 26
- Red: 26.01 - 85

June 29, 2007
Fire Weather Zones

- Based on Fire Weather Handbook
- Mapped by grouping Ecoregion Subsections
General Inputs

Wildland Fire Potential

Fuel Potential
- Surface Fire
  - Rate Of Spread
- Crown Fire
  - Flame Length

Weather Potential
- Extreme Fire Weather
- Energy Release Component
Extreme Fire Weather

Description:
Average number of days a year that experience extreme fire weather

Base Data:
Weather Stations
• Hourly observations: 1982 to 1997
• Temp, wind, & humidity thresholds
• Fires that destroyed many structures
• Interpolated using terrain correction
• Missoula Fire Science Lab, RMRS

Processing:
• Average the number of days
Extreme Fire Weather Potential

Legend:
- 0 - 4
- 4.01 - 8
- 8.01 - 14
- 14.01 - 26
- 26.01 - 112

June 29, 2007
General Inputs

Wildland Fire Potential

Fuel Potential
- Surface Fire
- Crown Fire

Weather Potential
- Extreme Fire Weather
- Energy Release Component

Rate Of Spread
Flame Length
Fire Weather Potential

Adjusted Number of Days Relative Average ERC Greater Than 95

Number of Days of Extreme Fire Weather Potential

Based on Number of Days Relative Average ERC is above 95 and Extreme Fire Weather Potential

Legend
- Very Low
- Low
- Moderate
- High
- Very High

Legend
- 0 - 4
- 4.01 - 8
- 8.01 - 14
- 14.01 - 26
- 26.01 - 112

$$\left( \text{Fire Seasons} + \text{Extreme Fire Weather} \right) \div 2 = \text{Weather Potential}$$
Fire Weather Potential

Based on Number of Days Relative Average ERC is above 95 and Extreme Fire Weather Potential

Legend
- **Very Low**
- **Low**
- **Moderate**
- **High**
- **Very High**

July 2, 2007
Fuel & Fire Weather Potential

Fuel Potential
Based on Crown Fire Potential and Surface Fire Predicted Rate of Spread and Flame Lengths

Weather Potential

\[
\text{Fuel & Fire Weather Potential} = \frac{(\text{Fuel Potential} + \text{Weather Potential})}{2}
\]

Legend
- Very Low
- Low
- Moderate
- High
- Very High

Maps show fuel potential and weather potential across the United States for different dates.
General Inputs

Wildland Fire Potential

Fuel Potential
- Surface Fire
  - Rate Of Spread
- Crown Fire
  - Flame Length

Weather Potential
- Extreme Fire Weather
- Energy Release Component

Ignition Potential
- All Fires
- Large Fires
Fire Occurrence

Description:
Number of Fire Starts

Base Data:
- 1980 to 2003
- All federal lands
- State & private lands with shared fire fighting responsibility
- Compiled by BLM (Denver Office)

Processing:
- Two Data Sets:
  - All fires > 0.10 acres
  - Large fires > 500 acres
- Explored summarizing to different units
  - Standardized to per million acres
All Fires (Greater then 1/10 Acres)

Federal and State/Private fires where fire fighting resources are shared.
1980 - 2003

Legend
- Fires 1/10 acre or greater
Large Fires (Greater then 500 Acres)

Federal and State/Private fires where fire fighting resources are shared.
1980 - 2003

Legend
- Fires 500 acres or greater
General Inputs

Wildland Fire Potential

Fuel Potential
- Surface Fire
  - Rate Of Spread
- Crown Fire
  - Flame Length

Weather Potential
- Extreme Fire Weather
- Energy Release Component

Ignition Potential
- All Fires
- Large Fires
Summarized to the County
Fire Occurrence

Average Number of Fires > 0.25 Acres Per 1 Million Acres
Summarized to the County and
Compiled from Federal & State Databases for 1986 through 1996

Legend
- 0 - 0.45
- 0.46 - 3.5
- 3.51 - 8.75
- 8.76 - 20.75
- 20.76 - 4,687.24

Average Number of Fires > 500 Acres Per 1 Million Acres
Summarized to the County and
Compiled from Federal & State Databases for 1986 through 1996

Legend
- Very Low
- Low
- Moderate
- High
- Very High

Fire Occurrence Potential
Based on Average Number of Fires Per 1 Million Acres
> 0.25 Acres and > 500 Acres

Legend
- 0
- 0.01 - 0.15
- 0.16 - 0.3
- 0.31 - 0.55
- 0.56 - 9.96

\[
\left( \frac{\text{All Fires}^* + \text{Large Fires}^*}{2} \right) = \text{Ignition Potential}
\]

*Quintile – five classes w/ each containing 1/5 the total population
Fire Occurrence – Summarized to County

Based on Average Number of Fires Per 1 Million Acres
> 0.25 Acres and > 500 Acres

Legend
- Very Low
- Low
- Moderate
- High
- Very High

June 29, 2007

Compiled from Federal & State Databases for 1986 through 1996.
Fire Weather Zones

- Based on Fire Weather Handbook
- Mapped by grouping Ecoregion Subsections
Summarized to Weather Zones

Fire Occurrence

Fire Occurrence Potential Zones Summary
Based on Average Number of Fires Per 1 Million Acres
> 0.25 Acres and > 500 Acres

Legend
Very Low
Low
Moderate
High
Very High

Compiled from Federal & State Databases for 1986 through 1996.

July 2, 2007

\[
\left( \frac{\text{All Fires}^* + \text{Large Fires}^*}{2} \right) = \text{Ignition Potential}
\]

*Quintile – five classes w/ each containing 1/5 the total population
Wildland Fire Potential

Final Steps

- Adjust Fuel and Fire Weather Potential
  - Based on Ignition Potential
  - Increase SE Fuel & Weather Potential by 1
- Add additional land forms (water, barren...)

Fuel and Fire Weather Potential

Ignition Potential

Legend:
- Very Low
- Low
- Moderate
- High
- Very High

July 2, 2007

Compiled from Federal & State Databases for 1986 through 1996.
Wildland Fire Potential

Based on Fuels Potential, Modified Weather Potential, and Incorporates Fire Occurrence

Legend
- Very Low
- Low
- Moderate
- Barren
- High
- Very High
- Agriculture
- Water
- Urb/devel/ag

July 2, 2007
How Good Is It

• Does it Pass the Straight Face Test
• National Scale
  Should not be used at finer scale
• Shows relative changes
• Temporary product
Where Do We Go from Here

• Wait for LANDFIRE National
• Calculate Potential Using:
  - FSPRO Model
  - FIREHARM Model
• Improve Weather Inputs
• Measure Potential Based on Empirical Data