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Wildfire Hazard, Potential, and Risk:
A description of concepts and a discussion of the Risk Assessment Process

Robert Ziel

Alaska Fire Science Consortium

A member of the Joint Fire Science Program Knowledge Exchange Network

What does Wildfire Risk Mean?

*"**Risk** is defined as a measure of the probability and consequence of uncertain future events"* (Thompson et al 2016). We are uncertain about many things each day, though only when that uncertainty interferes with a decision is a risk considered and possibly taken. In that framework, **wildfire risk** can be measured only if the underlying hazard can be clearly defined and understood.

Many recognize wildfire hazards as the fuels that burn intensely and the weather that encourages them to burn. This hazard is distributed unevenly across the landscape and over time as the weather changes. In an effort to characterize that distribution, **wildfire hazard** is defined and measured primarily in terms of fire intensity or flame length, both providing thresholds for extreme fire behavior.

Wildfire probability, likelihood, or potential depends on where, how, and how many fires ignite—and on the ability of fires, once started, to spread rapidly. Until recently, analysis tools have not allowed fire spread analysis to augment ignition density maps in the preparation of "hot spot" frequency maps that depict the spatial distribution of wildfire probability.

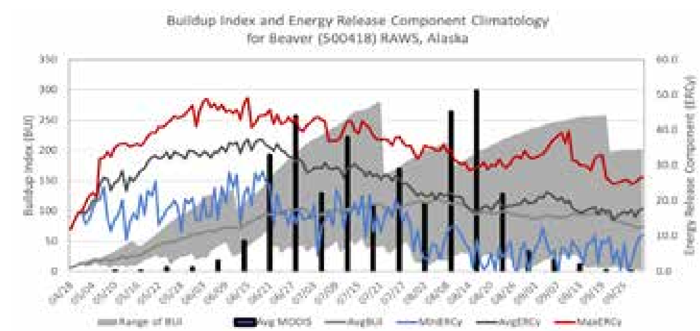
Consequences are distributed unevenly across the landscape. They are also distributed unevenly across our collective consciousness. Understanding wildfire risk requires a thorough inventory of what is considered valuable and a relative rating of them according to their importance and vulnerability to the wildfire hazard. Our efforts to record, store, and display these values as decision points like "critical" and "full" management option areas and as "known sites" are critical first steps in the evaluation of wildfire consequences.

How probability and consequence are combined varies widely in different wildfire risk assessment tools and processes. To date, our Community Wildfire Protection Plans (CWPPs) have made the most formal efforts to characterize wildfire risk. The Anchorage and Fairbanks CWPPs used similar processes to rate risk. This research brief attempts to discuss the similarities and differences among key approaches.

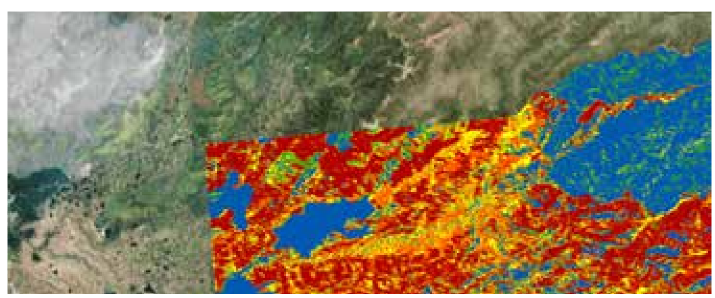
Mapping Wildfire Hazards

Among the biggest challenges in risk assessment efforts is producing an effective depiction of the **landscape hazard**. These products require accurate maps of fuels and terrain. Some products, like fire danger and drought assessment maps, make no attempt to map that variability because of the challenge it poses and the error it imposes on the result.

Along with landscape mapping, the spatial and temporal influences of **weather and climate hazard** on flammability are also laden with uncertainty. The model basis of fuel moisture estimation can impact overall flammability estimates. Consider how fuel moisture representations influence the results.



The resulting characterization of **wildfire hazard**, as fire intensity, combines current landscape with fuel moistures and wind conditions based on representative weather conditions:



This fire intensity map required a number of assumptions about the hazards you recognize from the landscape image underneath and the weather conditions applied. You might consider some of these questions:

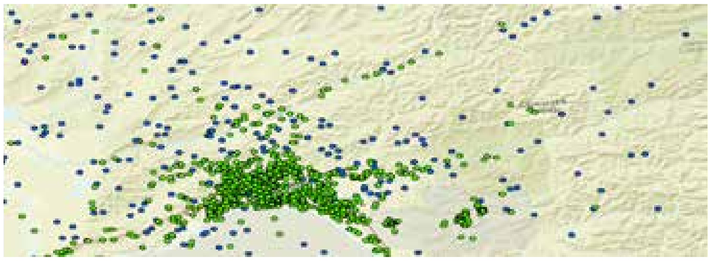
- What fuel classification system was used and how accurately does it represent the landscape hazard?
- Will the weather scenarios capture key thresholds?

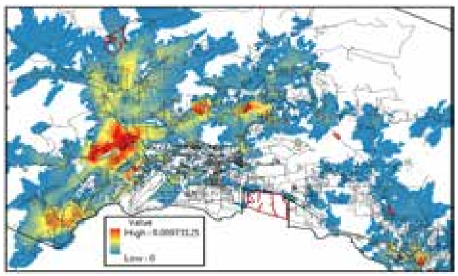
For more information, contact Robert Ziel (rhziel@ alaska.edu), or visit the Alaska Fire Science Consortium website:

akfireconsortium.uaf.edu

Mapping Burn Probability

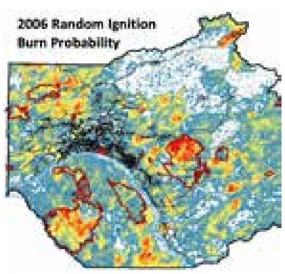
Alaska fire history has both a wealth of detailed fire history and important distinctions about causes and distribution. This map of the past 20 years of ignitions in the Fairbanks area shows the frequency and distribution of human (green) and lightning (blue) ignitions.





With human-caused fires, values at risk are often nearby, and ignition density has represented burn probability as effectively as this spread analysis.

But ignition distributions do not account for which fires spread more rapidly and impact larger areas, especially where hazardous fuels are an important contributor. With the advent of Farsite, FLAMMAP, and Prometheus spatial analysis systems, it is possible to combine ignition density and fire growth potential from them for entire landscapes.



This retrospective burn probability analysis, based on a 2006 landscape, highlights elevated likelihood in yellow and red colors. Note how subsequent large fire perimeters, in brown, align well with areas of elevated probability.

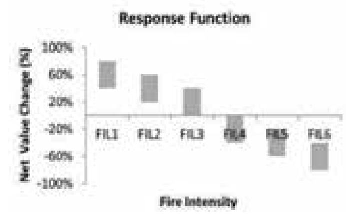
Combining Wildfire Hazard and Burn Probability

Generally, the question asked determines which ignitions are important and what weather conditions to impose in the assessment. Where fires start and how winds push them are key factors in probability analysis. However, the wildfire hazard as fire intensity is primarily a scoring of the landscape flammability. It can be probabilistic, based on the many times a pixel is burned in an analysis, or anticipated from a single forecast weather scenario.

Characterizing Risk Assessment Consequences

Traditional assessment tools, like fire danger ratings, do not formally integrate values at risk. Instead, they assume that no matter how likely, a fire once started poses a threat comensurate with anticipated flammability. Only with the application of spatial tools can the distribution and importance of values be applied in a true wildfire risk assessment.

A common misconception is that values are ranked on their dollar value. Assessed valuation is widely available for spatial representation. Consider, though, whether the assessed valuation of a home is the best indicator of how important it is to the occupant and the community. Effective integration of values into a risk assessment needs to recognize that there can be more than one value, sometimes competing for importance, at a single location.



Scott et al, 2013

Each of these values can have a characteristic **response to a wildfire**, based on the fire intensity that is experienced. Some responses may be beneficial, such as habitat benefits. Most difficult is finding consensus about the **relative importance** of those competing values.

Using the Wildfire Risk Assessment

The resulting map of relative risk is not an end to itself, though it can be quite illuminating. As mentioned at the beginning, uncertainty is widespread and everpresent. Risk rating is needed in a decision context. There are many possible uses for a good risk assessment.

The best and most prominent example here in Alaska is the map guiding planned response to wildfires in the Alaska Interagency Wildfire Management Plan. Another example is the mapped "Zones of Concern" that guide placement of fuel treatments in the Fairbanks CWPP. More and more sophisticated applications will change the way organizations and decisions are envisioned.

Citations

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Scott, Joe H.; Thompson, Matthew P.; Calkin, David E. 2013. A wildfire risk assessment framework for land and resource management. Gen. Tech. Rep. RMRS-GTR-315. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 83 p.

Thompson, Matthew P.; Zimmerman, Tom; Mindar, Dan; Taber, Mary. 2016. Risk terminology primer: Basic principles and a glossary for the wildland fire management community. Gen. Tech. Rep. RMRS-GTR-349. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 13 p.

UAF UNIVERSITY OF ALASKA FAIRBANKS

IARC International Arctic Research Center University of Alaska Fairbanks

ALASKA FIRE SCIENCE CONSORTIUM