A Review of Wildfire Terminology to Aid Decision-Makers

Bosa, A.R. [a*] and K. T. Weber [b]

[a*] The Resilience Institute at Boise State University, 1900 University Drive, MS 1535, Boise, ID 83725, USA, ashleybosa@boisestate.edu

[b] Idaho State University GIS Training and Research Center, 921 S. 8th Ave., stop 8104, Pocatello, ID 83209-8104, USA, keithweber@isu.edu

Abstract

Wildfire frequency is increasing globally, driving demand for improved tools to support mitigation, preparedness, response, and monitoring. At the same time, advances in satellite and aerial imaging have improved the availability of high-resolution, low-latency data products. However, many of these products are branded as "risk models" without clear alignment to the formal definition of risk, leading to confusion and misuse among end-users. This paper describes how foundational susceptibility models assess intrinsic landscape characteristics, while hazard models incorporate ignition likelihood, and risk models evaluate the potential consequences to valued resources. While these distinctions are well established conceptually, inconsistent terminology across vendors, practitioners, researchers, and policymakers has led to ambiguity in application. We further examine how wildfire risk metrics are incorporated into risk models, and their utility in a dynamic risk model for decision-makers in Idaho. Ultimately, aligning terminology, model structure, and metrics with their intended use is critical to ensure wildfire decision-support tools provide the most accurate, actionable information for emergency managers and other end-users.

Keywords

Wildfire; Risk Models; Hazard; Susceptibility

Highlights

- Wildfires are increasing, making better tools and clarity essential
- New technology helps track fires, but terms are often misused
- "Susceptibility" asks: can a place burn?
- "Hazard" asks: will a fire likely start here?
- "Risk" asks: what damage might occur if it burns?

1.1 Introduction

The frequency of wildfires is increasing worldwide (Iglesias, et al., 2022; Mansoor et al., 2022) and as a result, the need to mitigate and manage wildfires has become more urgent. Concomitantly, satellite and aerial spatial imaging platforms have proliferated over the past decade with the commercial sector seeing the fastest growth (e.g., AerialFire Staff, 2025; Lopes, 2025; Liu et al., 2025; Roy et al., 2021; Belward and Skøien, 2015). This growth is due in part to the emerging disaster-industrial complex and the demand for high spatial resolution imagery delivered from a task-able, low-latency platform. While these technological advances offer substantial benefits to emergency managers and other wildfire personnel, they also pose a potential problem in that some products are marketed as wildfire risk models without regard to the actual meaning of the term risk (Huidobro et al 2024). This paper seeks to provide guidance to emergency managers and other end-users of wildfire models by defining several key terms: susceptibility, hazard, and risk.

2.1 A Framework for Evaluating Susceptibility, Hazards, and Risk

Fire managers, emergency managers, and other wildfire response personnel increasingly require data and information that accurately predicts where and when wildfires are likely to occur, as well as the potential impacts those fires may have. However, the core components of wildfire preparedness, mitigation, and recovery, and the terminology used to describe their outputs, are not consistently aligned. The intersection of practitioners, researchers, and policymakers further complicates matters by introducing differing perspectives as well as terminology. These differences can create confusion and even conflict, as each set of terms is often tied to specific actions or decisions. To address this, it is important to clearly define and harmonize terminology, bringing disciplines into alignment and ensuring shared understanding among key end-users.

2.1.1 Susceptibility Models (Can It Burn)

Wildfire susceptibility models,

sometimes referred to as wildfire potential or threat models, attempt to quantify fire susceptibility of a landscape based solely on its intrinsic characteristics. These models include topographic drivers such as aspect and slope, as well as fuel load and fuel continuity indicators. Such indicators may be derived directly from imagery (e.g., normalized difference vegetation index (NDVI) used as a surrogate for biomass abundance), field observations, or a combination of these and other methods.

A wildfire susceptibility model represents a temporally static assessment of the landscape and by definition does not include ignition sources as these factors are not intrinsic to a landscape. Relative to a hazard or risk model, a wildfire susceptibility model has the least uncertainty and is designed to provide the end-user with an understanding of the potential for future wildfire events. If a wildfire occurs, those areas designated as having the highest susceptibility can be expected to result in a more destructive fire, but not necessarily a more severe or intense fire. A susceptibility model can be made temporally relevant (i.e., dynamic) through the inclusion of current fuel conditions as satellite imagery and/or field data become available.

2.1.2 Hazard Models (Will It Burn)

A wildfire hazard model builds upon a susceptibility model and furthers it by attempting to include ignition sources. In other words, a hazard model informs the end-user about the possibility that a wildfire may actually occur in an area. Common ignition sources considered in a hazard model include lightning as well as anthropogenic sources. Spatially quantifying ignition sources is challenging and introduces additional uncertainty in the model relative to a susceptibility model. For instance, while lightning is not a random event (Dwyer & Uman, 2014) it is also highly unpredictable with any spatial certainty (Weber 2023). Thus, generalities are typically made based on past lightning strike patterns and trends. Modelling human-caused (anthropogenic) wildfire ignitions is fraught with even more uncertainty. Within a hazard model human-caused wildfire ignition is sometimes quantified by the presence or density of homes, structures, or even roads which are considered surrogates for human presence and activity. This approach incorrectly assumes all people are equally likely to ignite a wildfire and omits deliberate arson events simply because these are effectively impossible to model spatially.

2.1.3 Risk Models (What Happens If It Burns)

Wildfire risk models typically build upon a hazard model. The risk model responds to the end-user question of "If a fire occurs, what area poses the highest risk to life and property". Other wildfire risk models may focus on environmental or ecosystem risk, endangered species habitat, or critical infrastructure sites. By definition, risk models focus on a particular feature or area considered to be at risk.

Adding to the complexity of these models, wildfire risk not only includes the product of natural processes, but also human behaviors (Dickinson et al., 2015). For example, past fire suppression policies and drought conditions can increase fuel loads and elevate the likelihood of future wildfire occurrence. At the same time, expanding development along the wildland–urban interface (WUI) raises the values of properties at risk when fires do occur, and arguably may increase the ignition potential due to increased human activity. Together, these factors substantially amplify overall wildfire risk.

From the above definitions, it becomes clear that susceptibility, hazard, and risk terms are not **synonymous and clarity is important in the distinction between each term.**

3.1 Discussion

3.1.1 Key End-Users

Emergency Managers, fire planners, and respective fire agencies (e.g., Idaho Department of Lands, U.S. Forest Service, etc.) use models and other decision-making tools to help assess wildfire susceptibility, hazard, and risk in Idaho and other states. However, the language used currently to characterize fire management and fire preparedness has seemingly become less concise over time (Hardy, 2005). Although terms such as "risk" and "hazard" have been formally recognized in fire management since the 1920s, the nomenclature is not well defined and has trended toward an all-risk approach for some agencies, and not others, which has resulted in ambiguity and inconsistencies in the use of most wildfire terms (Hardy, 2005).

Having clear and correct definitions of wildfire susceptibility, hazard, and risk helps decision makers and emergency managers interpret models correctly and apply them appropriately in planning and response.

Each term represents a different level of analysis and uncertainty, and understanding these distinctions prevents misinterpretations and improves decision quality. In other words, clear terminology ensures that emergency managers and fire management personnel do not treat a susceptibility map as a prediction of fire occurrence or a hazard map as an assessment of community risk.

3.1.2 Building a Fire Risk Model for Idaho

Fire metrics used to characterize and understand the impacts of wildfires are central to risk modeling. A wildfire risk model, using the terminology above, inherently combines probability (the likelihood of fire occurrence) and outcomes (the consequences of that fire). In practice, however, additional risks are often incorporated to support a more comprehensive risk assessment for decision-making. Additional risk parameters may include **fire intensity** (which describe heat energy released from fire; Plumanns-Pouton et al., 2025; Keeley, 2009) and **burn severity** (more aptly applied to loss of organic matter in or on soil surface (Parsons et al., 2010; Keely, 2009). Broader predictive indicators, such as **drought indices** (McEvoy et al., 2019), are also frequently used to contextualize conditions that influence fire potential. While the addition of each parameter has the potential to improve a model and ultimately allow it to perfectly emulate reality, this level of accuracy has never yet been achieved. Instead, the errors inherent within each parameter propagates through the model resulting in a final product with high uncertainty.

However, the utility of each of these metrics depends heavily on the management context in which they are applied. Many of the indices (e.g., drought), operate on long temporal scales or rely on lagged data, which limit their utility in a dynamic fire risk model intended to support real-time decision-making during active wildland fires. Fire managers for active wildfires operating in incident response often require real-time or near-real time, rapidly updating information rather than indicators that reflect broader seasonal or antecedent conditions.

This distinction highlights an important challenge; that metrics, models, and terminology for risk do not always translate effectively to the fast-paced, operational environment of active fire management. This is particularly true when the fire itself begins to affect and modify weather conditions within the vicinity of the wildfire. This is especially apparent with fire-generated thunderstorms (i.e., the development of pyrocumulonimbus clouds).

In contrast, pre-fire risk management strategies used to plan prescribed burns, fuel treatments, and other reduction efforts, are more compatible with these longer-term metrics. In this context, drought indices, historical fire patterns, and burn severity data for similar vegetation types can meaningfully inform where to implement treatments and reduce future impacts. In this instance, the use of a wildfire hazard model may not be necessary as a fuel load reduction treatment area can be identified using a fire susceptibility model. Consequently, it is pertinent to align any wildfire model with their intended use, and ensure each provides actionable information for end-users.

4.1 Conclusions and Future Directions

In summary, as wildfire activity increases and technological capabilities expand, the need for clear, consistent terminology in wildfire modeling has become increasingly important. Distinguishing between susceptibility (can it burn), hazard (will it burn), and risk (what happens if it burns) provides a structured framework that helps align diverse perspectives across practitioners, researchers, and policymakers. Without this clarity, models may be misinterpreted, leading to ineffective or mismatched decision-making.

Furthermore, the applicability of the fire metrics varies depending on management context: longer-term indicators are well suited for hazard mitigation and pre-fire planning, while dynamic, and near-real-time data are essential for active fire response. Recognizing these differences and aligning models, metrics, and terminology with their intended use is critical for meaningful, actionable insights for end-users.

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