

Community Wildfire Vulnerability Index for Risk Assessment and Response Planning using Earth Observation (EO) Data and Modeling

Abstract

Catastrophic wildfire economic losses in recent years underscore the need to more accurately estimate vulnerability, loss potential, and future risk to support effective risk management decisions. This research is being funded by the NASA Applied Sciences Wildland Fires Program and aims to develop a novel *Community Wildfire Vulnerability Index* using data derived from Earth Observation (EO), wildfire hazard maps that define WUIs, building-level damage or vulnerability functions for wildfire damage and loss, community wildfire planning and design tools. The project is led by ImageCat scientists along with researchers from UC Irvine and aims to foster collaboration with the Fire Protection Research Foundation to ensure that the research outcomes provide meaningful real-world applications and solutions to end-users. Innovative approaches with EO data will be used to develop wildfire vulnerability index to help communities and other public and private stakeholders determine which physical and social assets are likely to be impacted by wildfires to enable targeted risk mitigation and prevention measures. A unique aspect of this research is utilizing different EO data sources for developing new models of building vulnerability functions for wildfire damage and loss. Other research components include Wildland Urban Interface (WUI) mapping with new EO and Geographic Information System (GIS) based approaches, feature detection using multiple EO and GIS data sources for the development of vulnerability indicators, and vulnerability index validation and testing in communities in California.

Goals and Objectives

This research aims to develop a Community Wildfire Vulnerability Index using data derived from Earth Observation (EO), wildfire hazard maps that define WUIs, building-level damage or vulnerability functions for wildfire damage and loss, community wildfire planning and design tools. The following are research sub-objectives that will enable and inform the development of the Community Wildfire Vulnerability Index:

- Applicability of various EO sensors for wildfire detection and validation
- Development of new models for Wildland Urban Interface (WUI) mapping
- Creation of data driven wildfire building-level vulnerability (response functions)
- Integration of community-level indicators on exposure, vulnerability, and adaptability to wildfires, including aspects on disaster preparedness and community design
- Validation of the wildfire vulnerability index using recent fire impacts
- Community stakeholder engagement to validate feasibility of application in decision making



Figure 1 Categories of Vulnerability Indicators for Developing Community Wildfire Vulnerability Index.



Significance of Project and Intellectual Merit

The project brings together disaster experts, remote sensing/GIS scientists, civil/structural engineers, urban planners, modelers, computer scientists, government agencies involved in wildfire risk management, insurance companies and community stakeholders to develop an innovative index for community vulnerability. The project aims to develop novel application of vulnerability index that allows targeted mitigation and adaptation measures, useful for a variety of stakeholders at different decision-making levels.

The project is well aligned with the NASA Applied Sciences Wildland Fires Program that focuses on EO and models to support decisions and actions, promote innovation and build capacity for communities to reduce wildfire risk before, during and after events. A key component underpinning the index is estimation of building damage and loss from EO data and model the exposure to communities most at risk. The index will enable efficient risk mitigation and prevention actions from a pre-disaster perspective and help reduce vulnerability of communities.

Potential stakeholders that would benefit from this research include governmental agencies involved in wildfire risk management at different levels. Organizations such as Cal Fire, IBHS, Cal OES, FEMA, local governments, and planning agencies, insurance companies stand to benefit from the outcomes.

Project Team



ImageCat: ImageCat, Inc. is a risk management technology company specializing in innovative solutions to risk assessment and management. Established in March 2000, the company has developed a reputation for innovative solutions in disaster risk assessment and reduction, quantification of the built environment, software development and post-disaster damage assessment. The company is built around a core group of engineers and scientists who are dedicated to developing multi-disciplinary solutions to complex risk issues and problems. ImageCat has over 15 years of experience developing innovative, advanced, technology-driven approaches to identify and map wildfire perimeters and structural damage, and to provide estimates of building damage.



University of California, Irvine (UCI): The Boundary Layers and Turbulence (BLT) lab at the Department of Civil and Environmental Engineering at UCI led by co-I Banerjee has been involved in several aspects of wildland fire research, ranging from fluid mechanics-based modeling of fire behavior in a high resolution (meter

scale) to large scale remote sensing-based mapping. Banerjee leads the SPARx project (Smart Practices and Architectures for Prescribed-Rx fires) aimed at transforming prescribed fire practices for California, a large-scale multi-campus effort across the University of California System. The BLT Lab has also published research on how wildfires have changed over the past century in California using extensive records from CalFire and have also identified how the fire regime has been shifting in the last two decades.



Fire Protection Research Foundation: The Fire Protection Research Foundation, the research affiliate of the National Fire Protection Association (NFPA), provides its Research Advisory Services program, which works to actively support entities conducting fire safety research consistent with NFPA's mission (to make the world safer from fire and other hazards). The program provides guidance, input, and resources on a broad range of fire safety issues, including fire loss, emergency response, the fire service, disaster resiliency, fire data, smart firefighting, sustainability, and electrical hazards, to name a few.

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