Managing Wildfire Risk in an Increasingly Complex Environment

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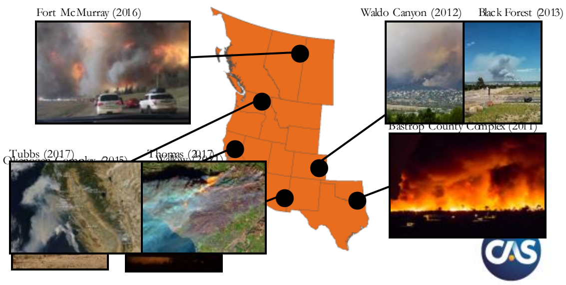
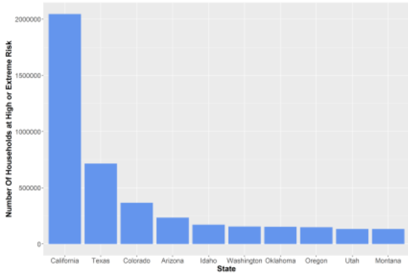
Agenda

- Wildfire Risk Today
- AIR Wildfire Model Domain
- Modeling Ignitions
- Spread Model
- Modeling Vulnerability

Wildfire Risk is Growing in the Western U.S. and Canada



Top 10 Wildfire-Prone States (2017)



Number of households is based on data from the 2010 U.S. Census.
Source: Verisk Insurance Solutions – Underwriting and Verisk Climate units of Verisk Analytics®.

AIR Wildfire Model for the United States

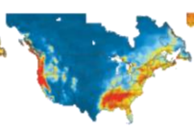
Historical Ignitions ≥100 Acres
1992–2015

- 13 top loss-causing states
- Contiguous modeling across western United States
- Model based on natural variability in annual fire severity due to variations in weather

Weather-Dependent Models Enable Correlated Countrywide Modeling of Wildfire Activity

Temperature

Precipitation



Drought

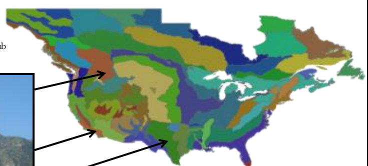
Wildfire severity is driven by **spatially** and **temporally** varying weather patterns

Relationships Between Weather and Fire Activity are Complex and Vary Spatially

Fine Fuels	Coarse Fuels
Fire behavior correlated to the drought conditions during the **growing** season	Fire behavior correlated to the drought conditions during the **fire** season
Wet Growing Season = ↑ Fire activity	Wet Growing Season = ↓ Fire activity
Dry Growing Season = ↓ Fire activity	Dry Growing Season = ↑ Fire activity

Wildfire Activity Modeled at the Ecoprovince Level

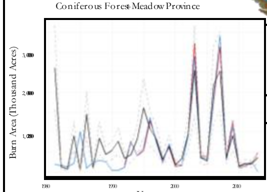
California Coastal Range Open Woodland-Shrub
- Coniferous Forest—Meadow Province

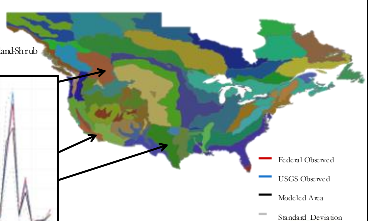


Ecoprovinces identify regions with similar ecosystems, climate, and vegetation—key drivers for fire behavior

Ecoprovince Approach Captures Unique Relationships Between Weather and Wildfire

California Coastal Range Open Woodland-Shrub Coniferous Forest-Meadow Province





Understanding the "Perfect Storm" for a WUI Disaster

Buildup of Fuels
- Forest/land management
- Long-term climate patterns

Ignition

Extreme Burning Conditions
- High winds
- Low moisture

WUI

Residential Areas
- Growing at-risk population

- Weather drives wildfire activity
  - Long-term weather and fuel conditions set the stage for large wildfires
  - Short-term weather conditions alleviate or exacerbate fire conditions
- Wildfires have a large social impact when they meet urban areas

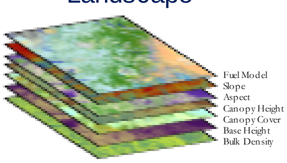
The WUI is Critical to Understanding Wildfire Risk

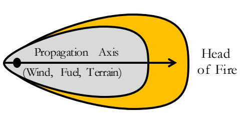

Cerro Grande Fire, Los Alamos


Santa Clarita Wildfire

- Development intersects with undeveloped lands
- Largest economic losses from wildfire will occur in the WUI
  - One-third of U.S. households are located in the WUI
  - 4,000 acres of wildland are converted to WUI *daily*

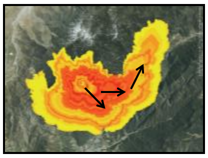
Physically-Based Model Realistically Captures Fire Spread Across a Landscape





Wind Speed and Direction are the Primary Drivers of Loss

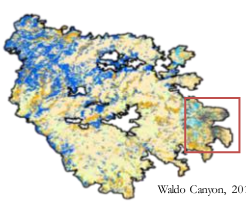
- Wind is the primary propagator of spread direction and wildfire intensity
  - Fires with high wind speeds produce higher losses
- Wind speed, fuel, and topography are considered when determining the final intensity



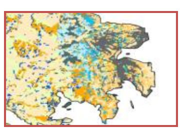
Spread Model Explicitly Accounts for All the Ways Fire Can Spread

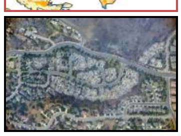
- Surface Spread
- Surface-to-Canopy Transition
- Canopy Spread
- Fire Branding/Spotting

WUI Penetration is the Biggest Driver of Loss

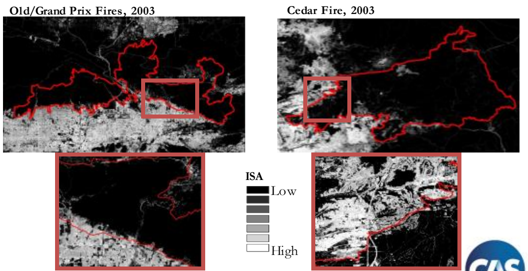


Waldo Canyon, 2012

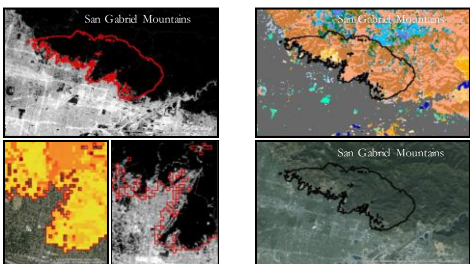




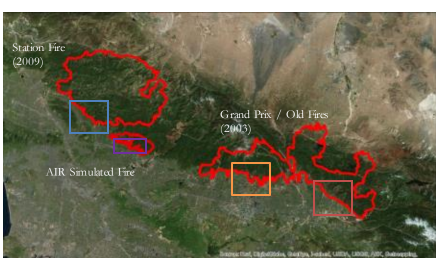
Impervious Surface Area (ISA) is Used as a Measure of Urbanicity When Modeling WUI Penetration



Model Realistically Captures Fire Spread into Urban Areas



Modeled Fire Perimeters Are More Granular



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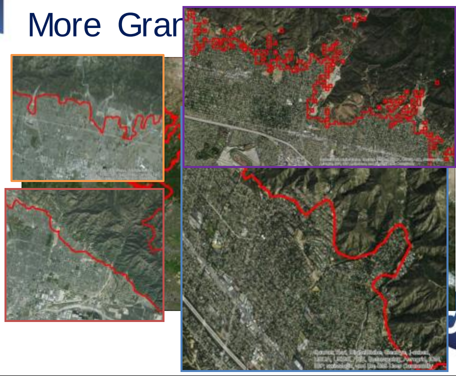
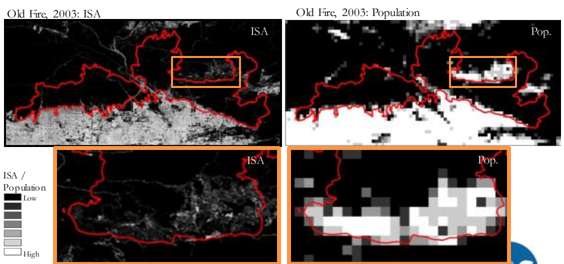
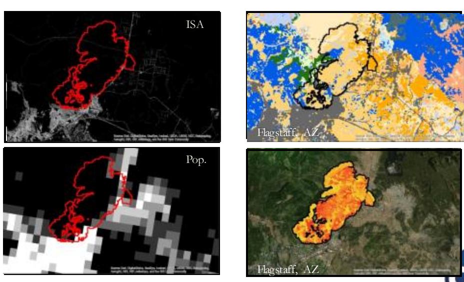


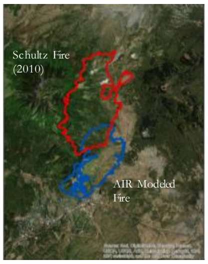
Population Is Used to Prioritize Suppression Resources



Model Accounts for Areas Where Fire Suppression Is Likely to Occur



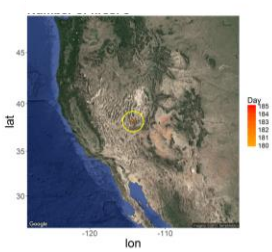
Comparison with Historical Fires: Schultz Fire, 2010



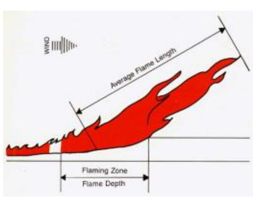
Unique Events are Identified by Clusters

Wildfires typically burn in clusters
- Northern CA Fires (2017)
- Southern CA Fires (2017)

- Cluster fires by hours clause



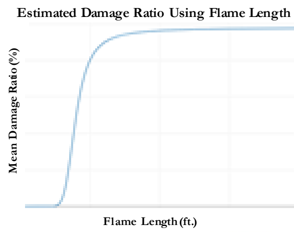
Building Damage Estimated Based on Flame Length



Building Damage Estimated Based on Flame Length

- Flame length is correlated with damage
  - 1-4 ft.: extinguish by hand tool
  - 4-8 ft.: too intense for hand tools
  - 8-11 ft.: serious control problems

Rothermel, 1983, How to predict the spread and intensity of forest and range fires, U.S. DoA



Binary Damage Pattern Revealed by Damage Surveys

Vulnerability Module

- Primary Risk Characteristics
  - Construction, Occupancy, Height, Age, Region
- Coverages A/B/C/D
- Secondary Risk Characteristics
  - Firewise community
  - Defensible space
  - Roof cover
  - Wall siding
  - Glass type
  - Roof aperatures

Photos from IBHS Wildfire Vulnerability Studies

Lessons Learned from Historical Wildfire Damages

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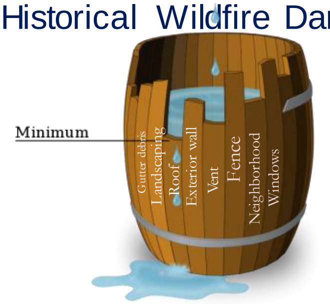
Lessons Learned from Historical Wildfire Damages



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Relative "Vulnerability" Across Construction/Occupancy/Height

Steel frame

Masonry

Wood frame

Secondary Risk Characteristics Capture Critical Factors Affecting Structure Vulnerability

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Roof type

Siding

Defensible space

Skylight and dormer

Questions and Discussion