ResilientAmerica Roundtable

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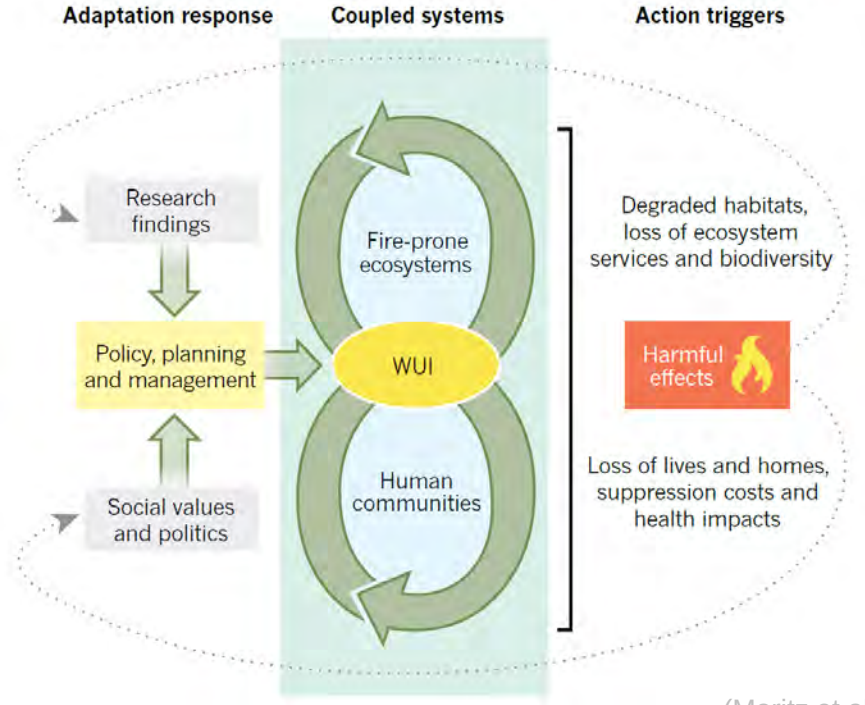
Bren School, UC Santa Barbara

September 2019

UC CE University of California Agriculture and Natural Resources Cooperative Extension

Moritz Lab UCSB

Coupled Systems



(Moritz et al. 2014)

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Punchline

- ***Problem***: The general perception of “the wildfire problem” is too simplistic.

- ***Solutions***: We won’t find them, until we have a better understanding of what to fix.

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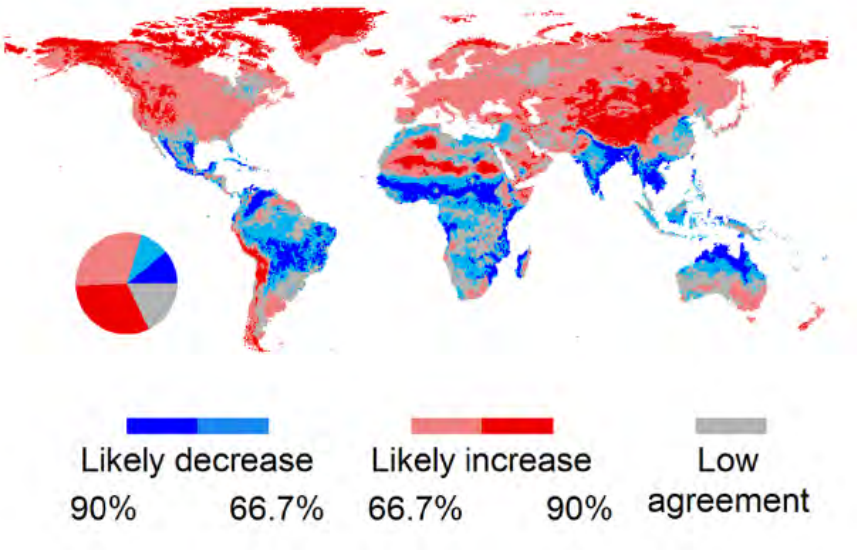
Increasing Fire Activity

Model Agreement: 2070-2099



(Moritz et al. 2012)

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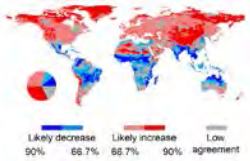
More Severe Forest Fires



(Wikimedia Commons)

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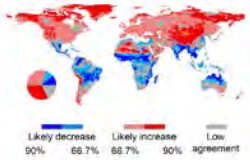
More Homes Lost



(USFS Lake Tahoe Basin Management Unit)

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More Disasters

(AP Photo/
Marcio Jose Sanchez)

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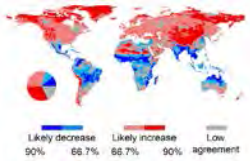
Lab

Is this really a causal chain of events and impacts?



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What is common here, despite vast differences?

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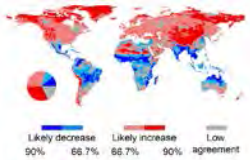
Is this really a causal chain of events and impacts?



No: Most homes burn due to embers

No: Most home losses are not in forests

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Which Problem?

- ***Forest losses***, in the face of more extreme droughts, pest outbreaks, and fires, is one set of problems.

- ***Home losses*** are not a “forest fire” problem, but one of ***where and how we build our communities***.

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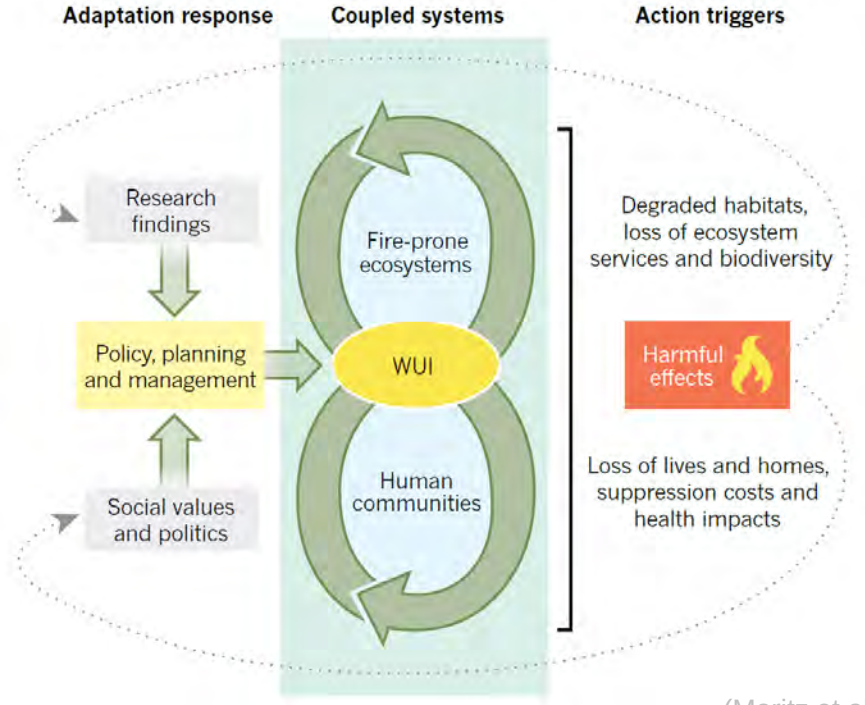
Coupled Systems



(Moritz et al. 2014)

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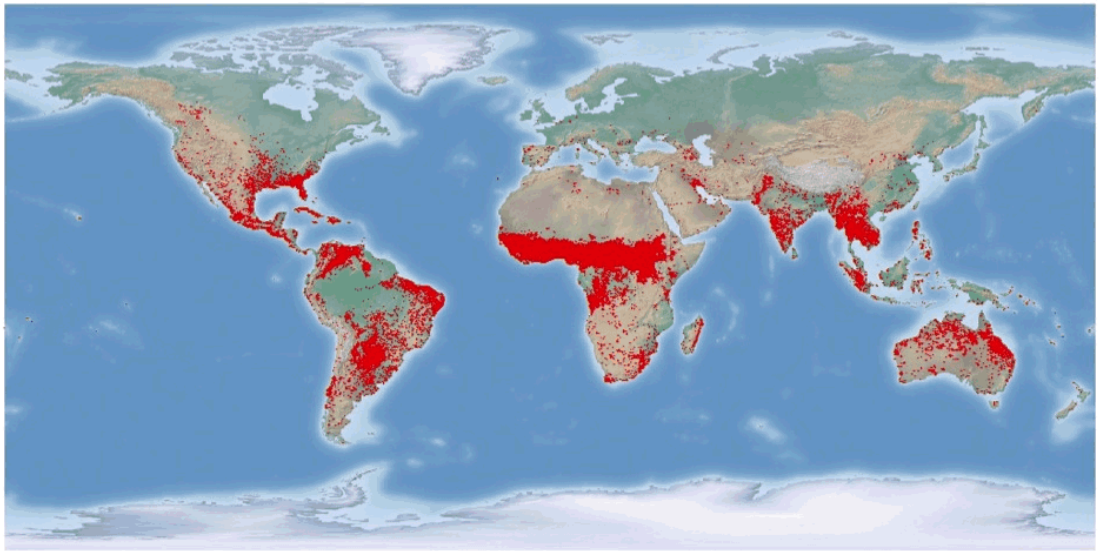
Why are questions related to climate change so challenging?

2012 MODIS Active Fire Detections from the Aqua and Terra Satellites



January February March April May June July August September October November December

Active fires, shown in red, are detected using MODIS data from the Aqua and Terra satellites
Source: NASA Fire Information for Resource Management System (FIRMS) https://earthdata.nasa.gov/firms

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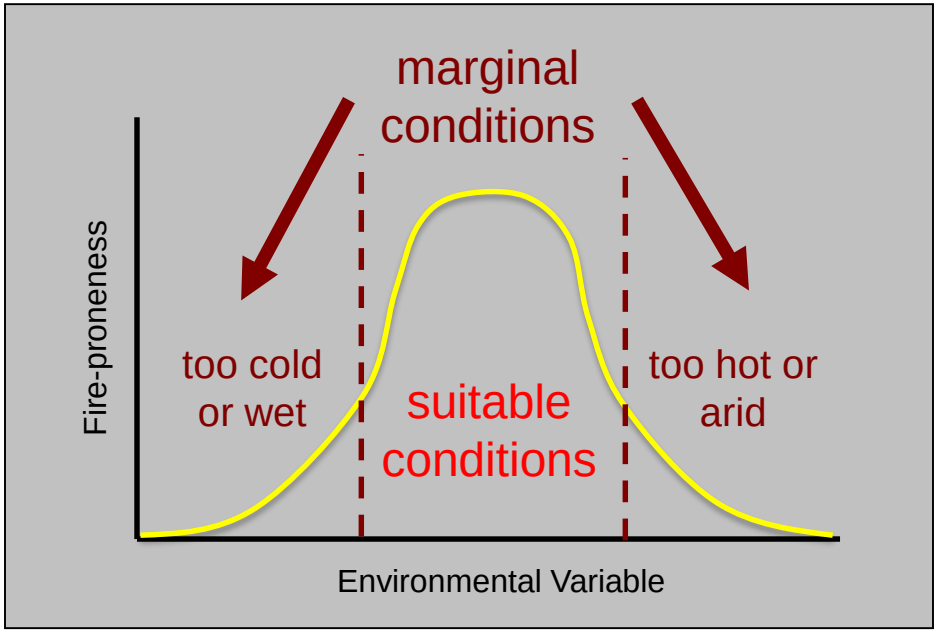
Fire Probabilities & Environmental Gradients



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Species Distribution Modeling!

Fire Regime Controls

- ***Fuel amount***: environmental constraints on biomass productivity (i.e., resources to burn).
- ***Fire season***: environmental conditions promoting flammability.
- ***Ignitions***: spatial/temporal patterns.

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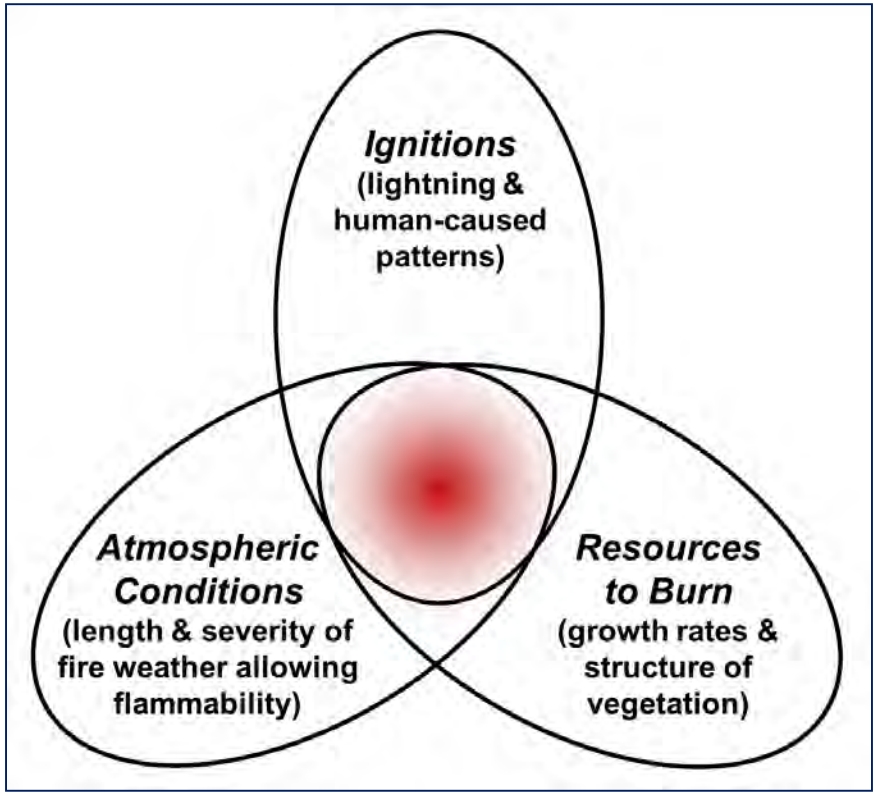

(Moritz et al. 2012)

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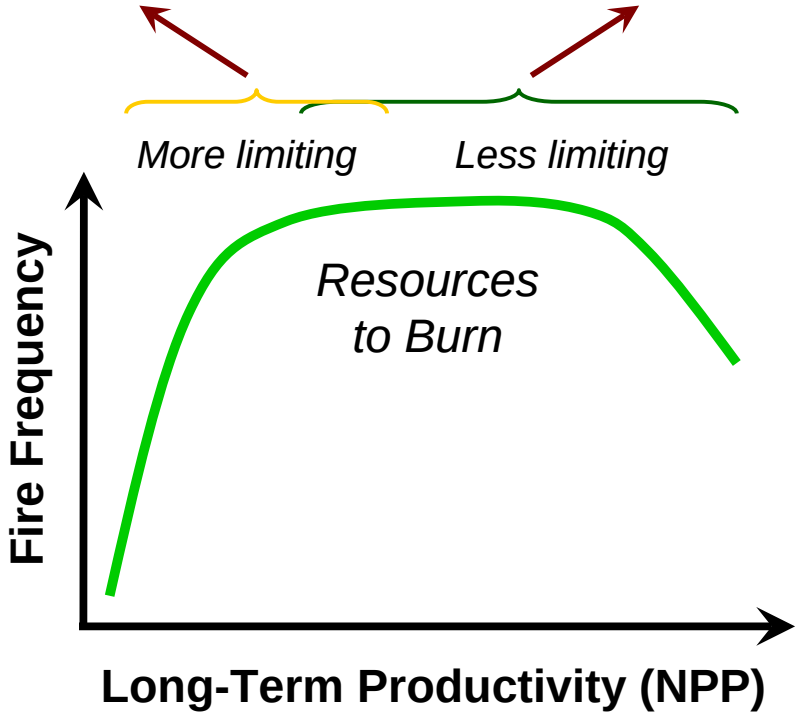
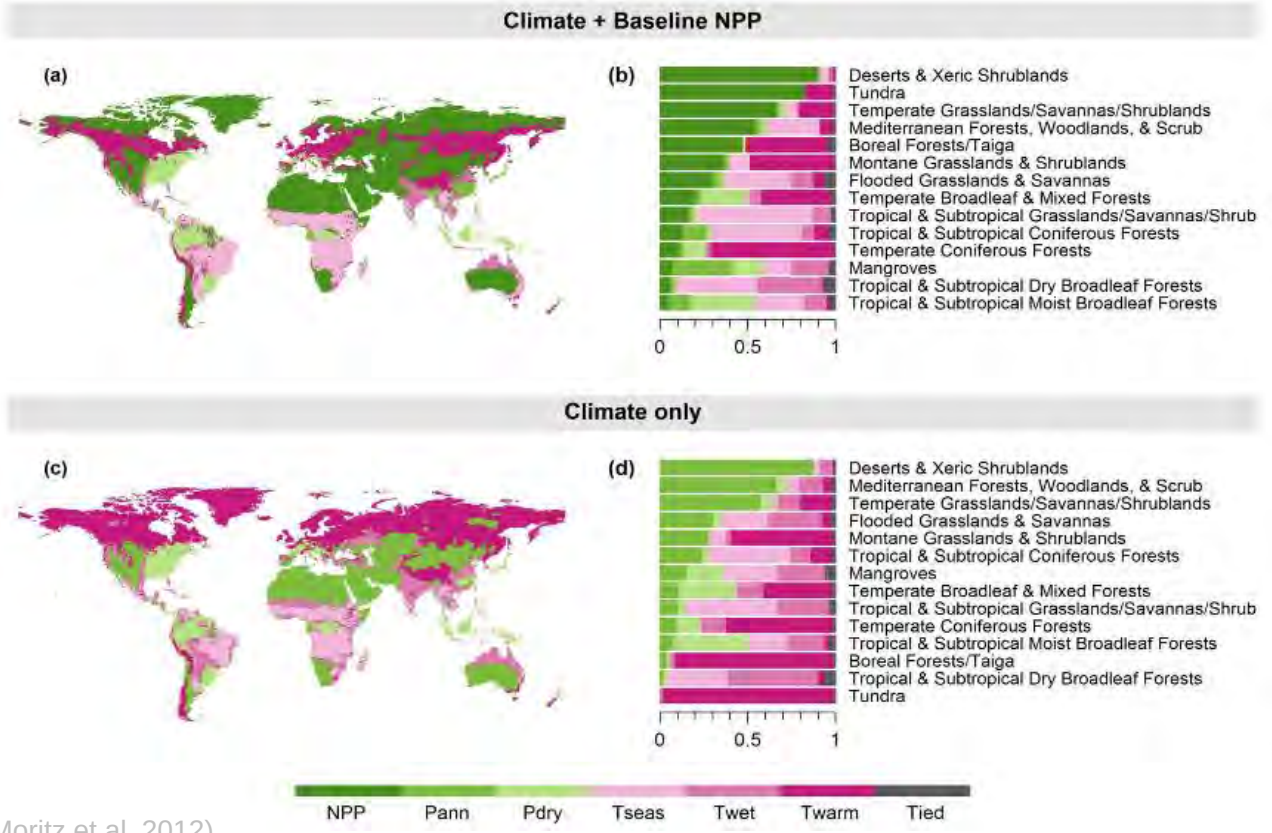
Sensitivities: changes in environment that support biomass growth (e.g., precipitation pulses)

Sensitivities: changes in ignitions, fire-conducive atmospheric conditions (e.g., droughts, hot & dry winds)



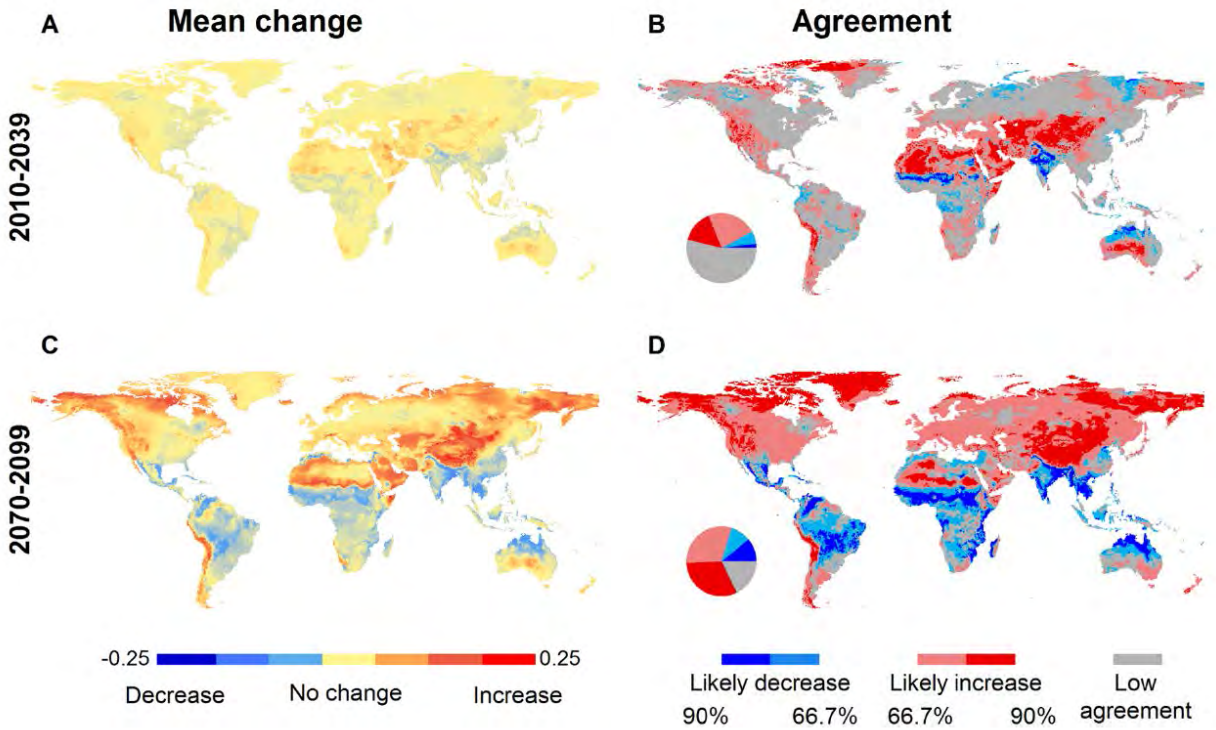
(Moritz et al. 2012)

Controls?



(Moritz et al. 2012)

Global Ensemble Model Projections



(Moritz et al. 2012)

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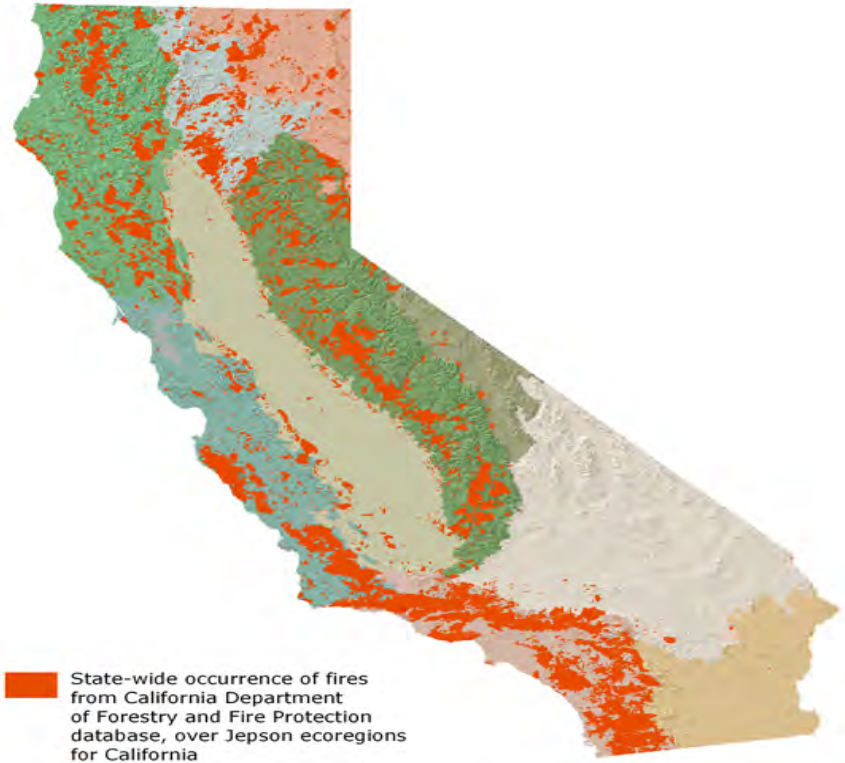
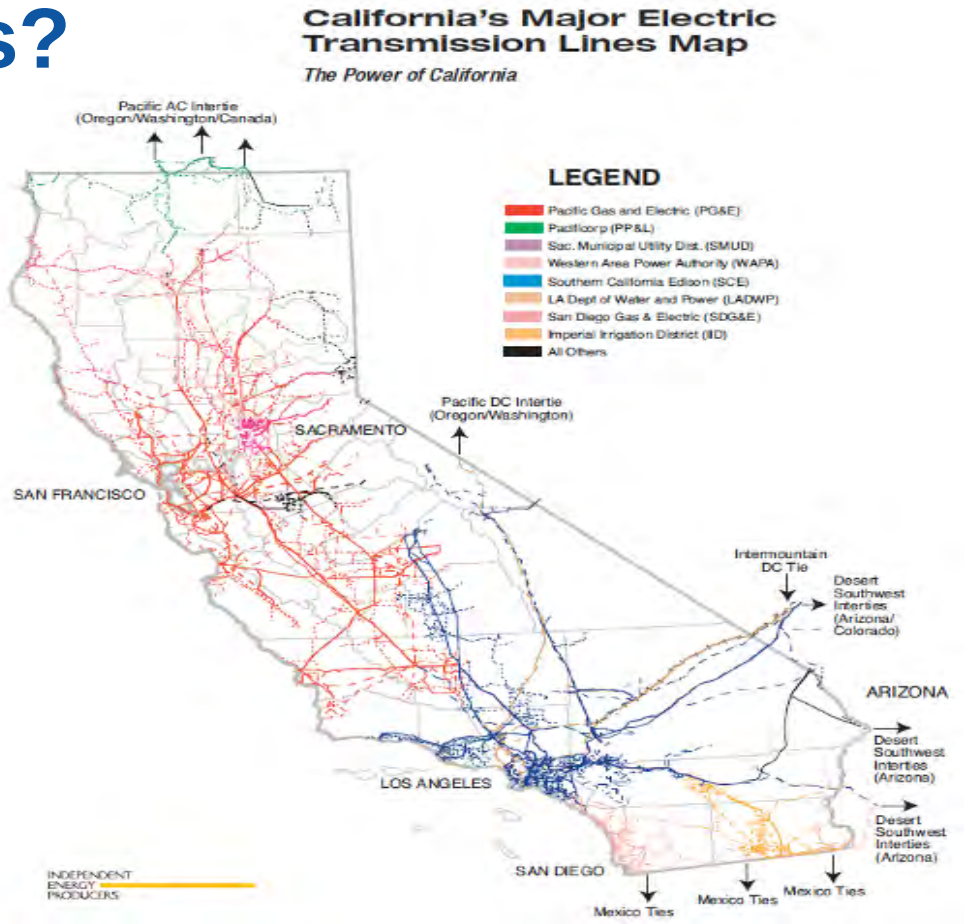
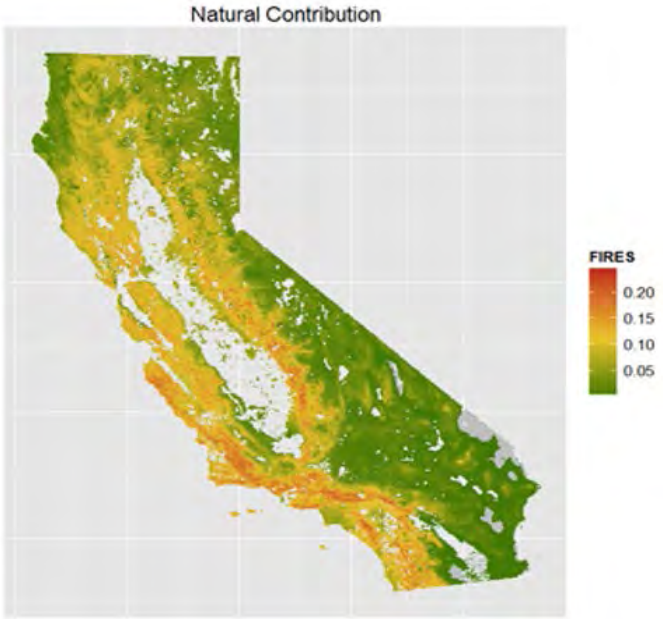
Finer Scale: Humans?

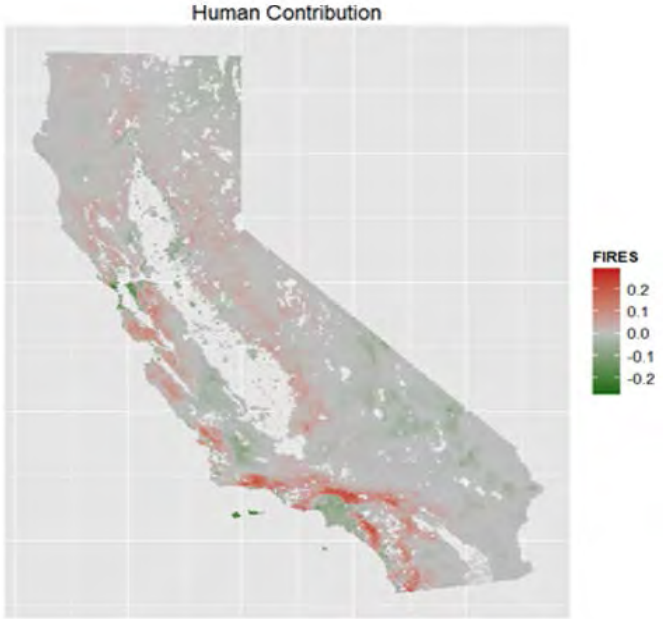


State-wide occurrence of fires from California Department of Forestry and Fire Protection database, over Jepson ecoregions for California



Including Human Dimensions



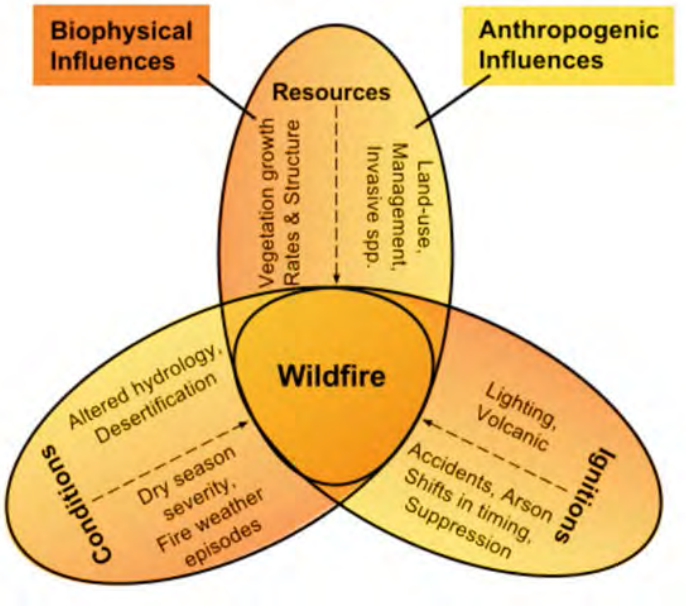


(Mann et al. 2016)

Including Human Dimensions

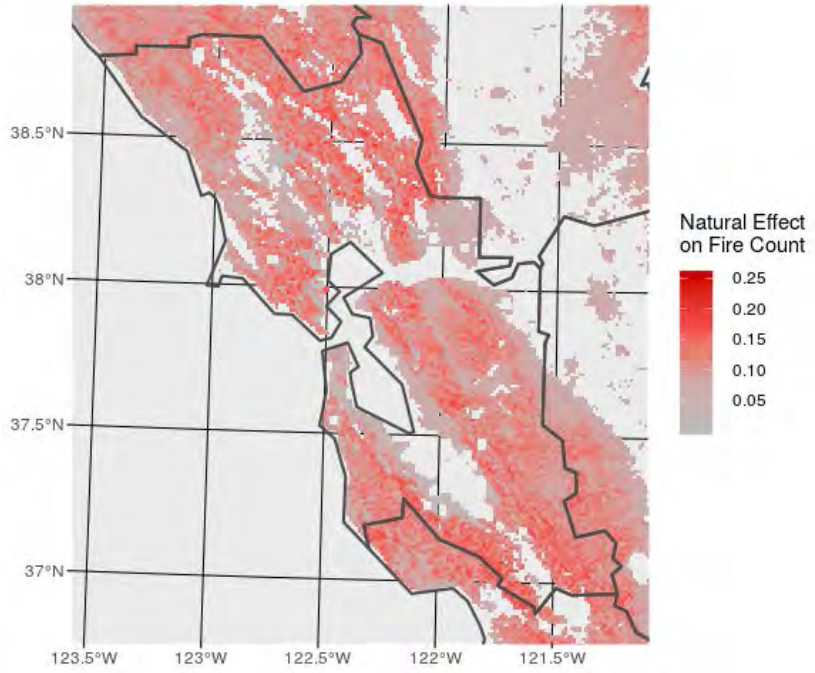
(Mann et al. 2016)

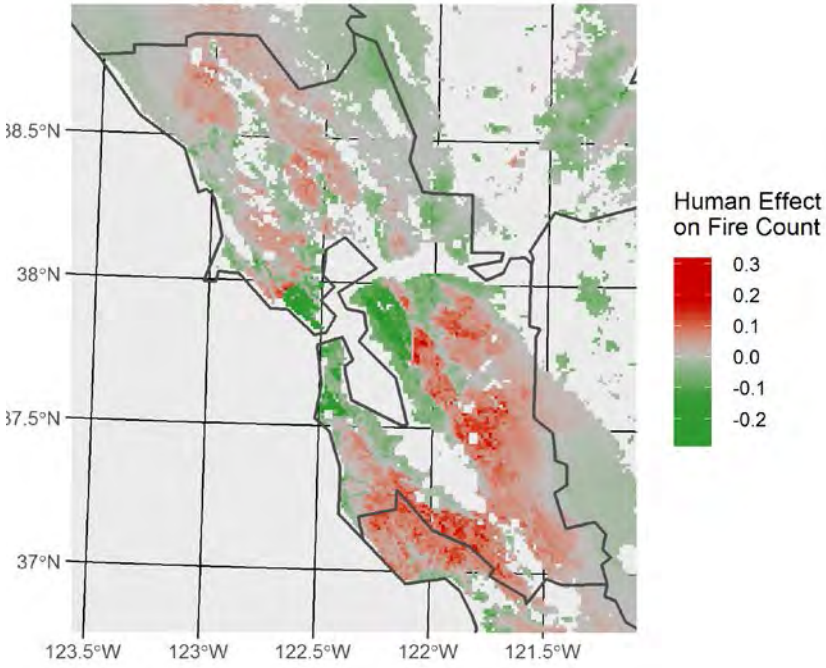
Human Influences are Key at Finer Scales!



(Mann et al. 2016)

Humans Drive Exposure AND Hazard





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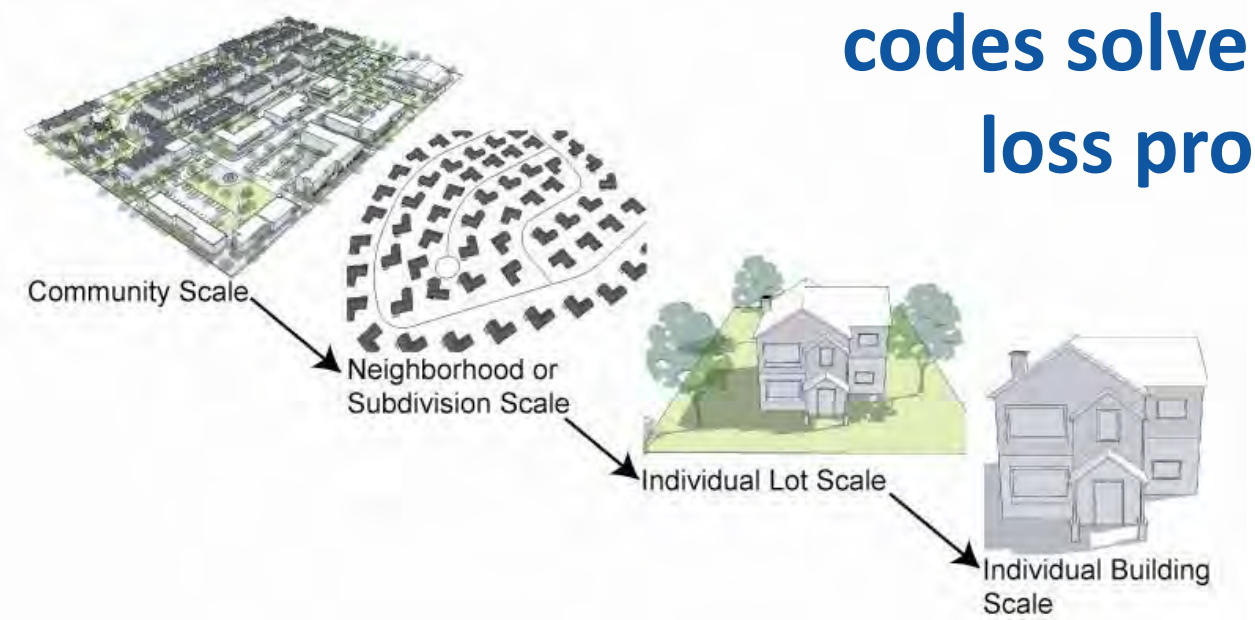
(Mann et al. 2016)

Role of Planning Decisions

Won't better building codes solve the home loss problem?



(Duerksen et al. 2011)

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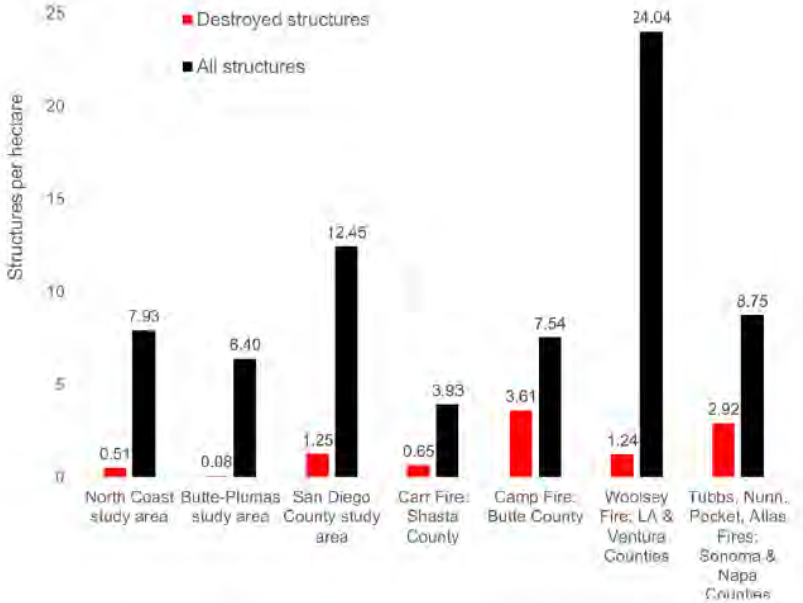
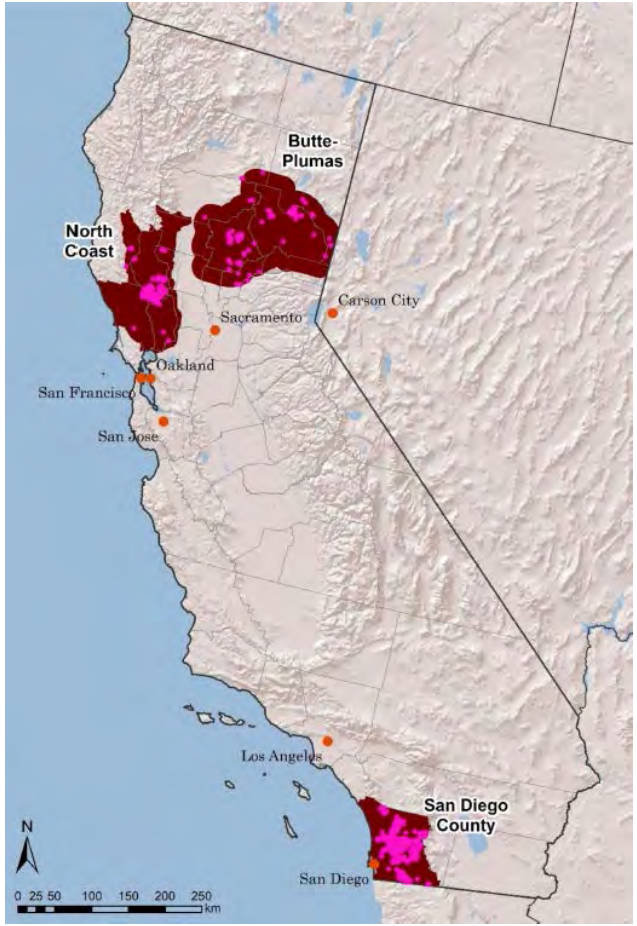
Density Matters!





(Syphard et al. 2019)

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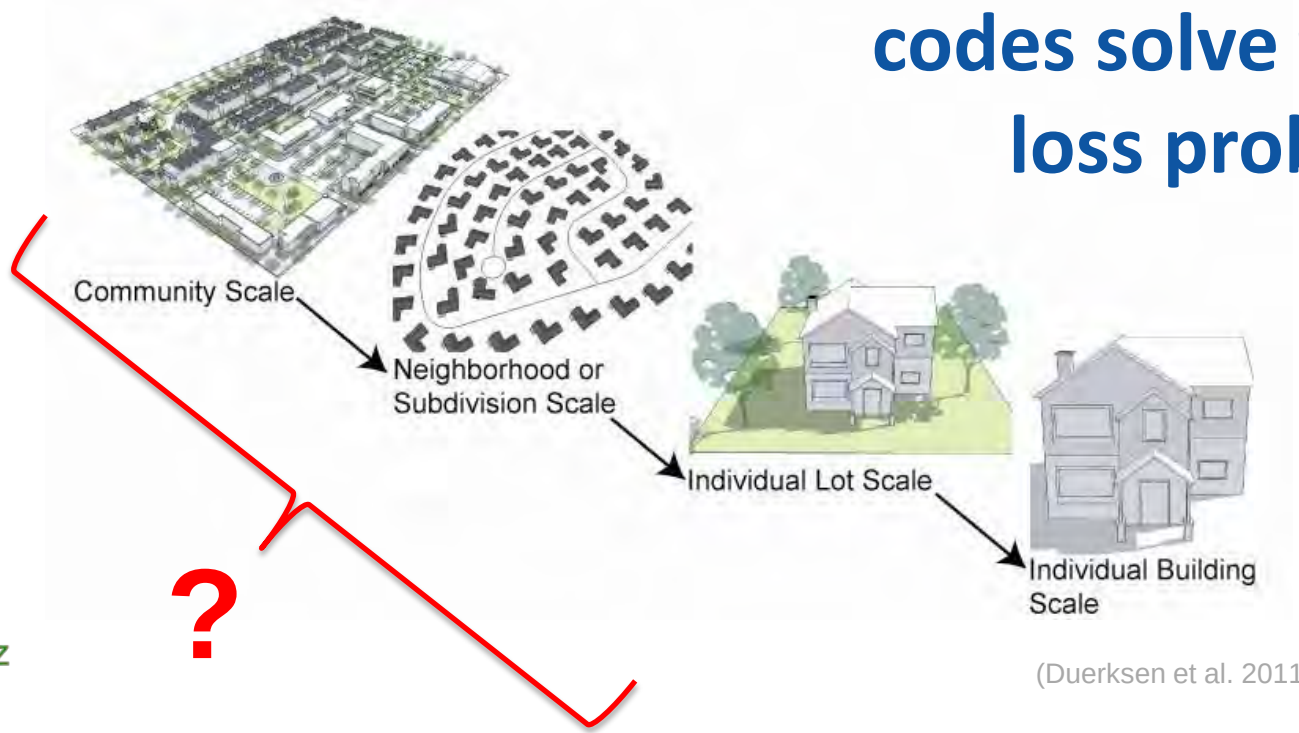
Role of Planning Decisions

Won't better building codes solve the home loss problem?



(Duerksen et al. 2011)

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What else is Missing in Urban Planning?

Siting and layout

Earlier integration

Design Element	Action	Scale	Goal
Landscape context of wildfire hazard	Engage in strategic planning much earlier	Community & subdivision	Include risk reduction measures before other considerations finalized
	Use hazard maps	Community location	Concentrate in least hazardous areas
	Use major landscape features	Community location	Buffer against oncoming wildfires
Separation from wildfire source	Use nonflammable amenities in design	Subdivision layout	Maximize defensible space
	Employ safe setbacks on slopes	Subdivision layout	Maximize defensible space
	Concentrate along inner side of roadway	Subdivision layout	Maximize defensible space
Density management	Cluster with other homes	Subdivision layout	Reduce collective exposure
Infrastructure concerns	Harden public facilities & refuges	Subdivision layout	Safeguard vulnerable populations; fallback for worst-case conditions
	Augment water requirements	Subdivision layout	Ensure redundant supplies; employ exterior sprinklers
	Locate power lines underground	Subdivision layout	Reduce ignition potential

Critical redundancies

Mitigation of extremes

(Moritz & Butsic, in review)

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Siting: New Communities

Risk Reduction Measure:
Avoid locating subdivisions in the highest hazard portions of the landscape, thereby concentrating development in less dangerous areas.

Dev Std LU-2: Sea Level Rise and Coastal Hazards. Sea level rise and coastal hazard analyses shall be required for near-shore development. Using best available science, the coastal hazard analysis shall consider the impacts of sea level rise on the proposed development including vulnerability assessment, and identification of adaptive measures to reduce expected risk and increase resiliency to sea level rise. Near-shore development includes sites on and along the beaches, bluffs, tidally influenced water bodies and areas potentially subject to inundation given topography and proximity to the ocean.

Dev Std LU-3: Fire Protection. Development shall be sited to minimize exposure to fire hazards and reduce the need for grading, fuel modification (including thinning of vegetation and limbing of trees), and clearance of native vegetation to the maximum extent feasible. Building sites should be located in areas of a parcel's lowest fire hazard, and should minimize the need for long and/or steep access roads and/or driveways.

Dev Std LU-4: Radon. Development proposed on Rincon Formation soils or within state-mapped elevated radon hazard zones shall be avoided to the extent feasible; if infeasible, development shall be subject to an evaluation of conformance to EPA radon gas exposure standards. For any sites exposed to radon gas levels exceeding acceptable health standards, incorporation of construction techniques, which reduce the interior radon gas concentrations to acceptable levels, shall be required.

(Siting requirements in Land Use Development Standards for Gaviota Coast Plan, Santa Barbara County California, 2016)

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Siting: New Communities

Risk Reduction Measure:
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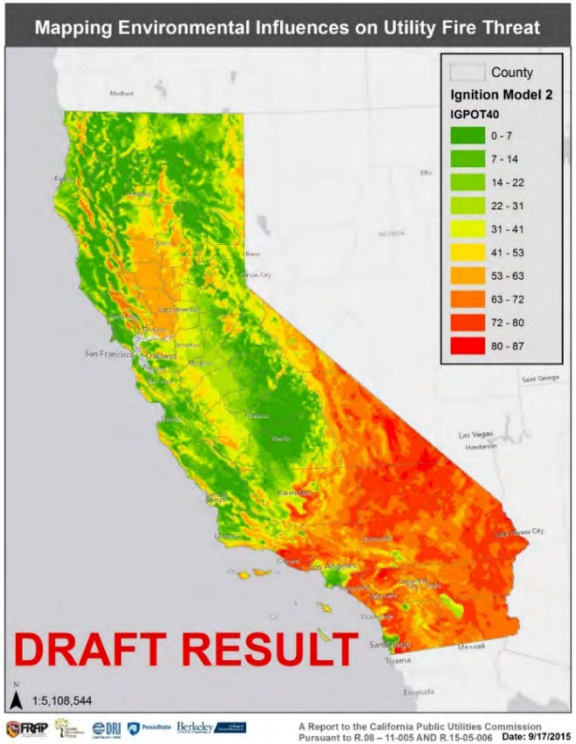

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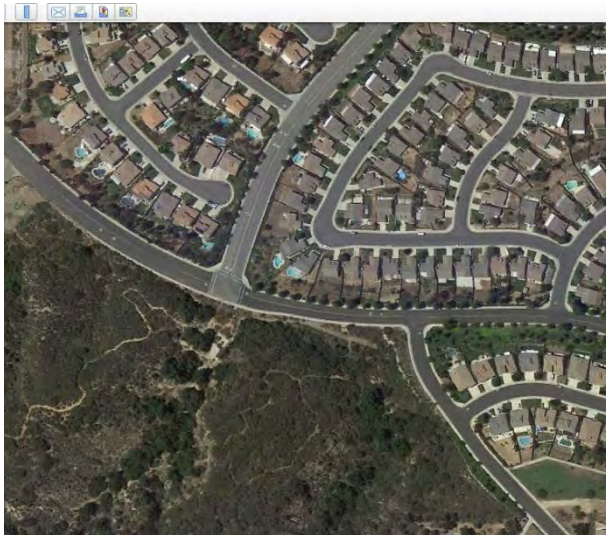
Design: New Communities

Risk Reduction Measure:
Concentrate building of homes on inner side of perimeter roads to maximize defensible space.



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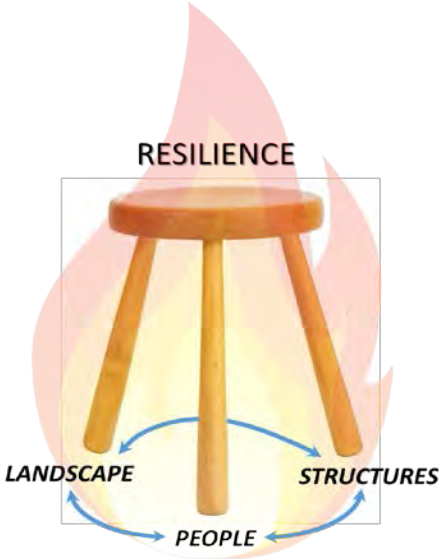
What about existing communities?

Need: Regional Wildfire Mitigation Programs



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Who Is Using?

Mitigation: CAL FIRE

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FRAP Projects

Download the Data

- PDF statewide map
- Zipped geodatabase with metadata

Fire Probability for Carbon Accounting

The Fire and Resource Assessment Program (FRAP) at CAL FIRE is investigating methods for estimating the likelihood of fire occurrence across the State of California in the coming decades. As part of this effort, FRAP has created a map of annual fire probability for the period 2026-2050, derived from a statistical model of fire occurrence created at the University of California, Berkeley. This map is intended for use in the quantification of GHG benefits of fuel reduction activities funded under the 2016-17 Greenhouse Gas Reduction Fund (GGRF) Forest Health Program.

Data Access Web Tool

This web-based tool will allow you to select, draw, or upload a project area polygon and summarize the fire probability information from this dataset.

Click here to open the tool in a web browser.

Data Download

- PDF statewide map
- Zipped geodatabase with metadata

Data Information

Title: California Annual Fire Probability 2026-2050 (Percent)

Summary: This data represents projected probability of fire occurrence (%) for California, 2026-2050. It was derived by CAL FIRE from work performed by Mann et al. (2016), and is intended for use in greenhouse gas accounting in the CAL FIRE Forest Health Program.

Description: Annual probability of fire occurrence (%), derived from Mann et al. (2016) projections for 2026-2050. Source data represents projected mean fire return intervals (MFRI), derived under A2 emissions scenario in both GFDL and PCM climate models. MFRI projections for two models were combined by taking minimum MFRI for each cell, inverted to get annual probability, then multiplied by 100 to get percent value. Derivation was performed by the Fire and Resource Assessment Program (FRAP), California Department of Forestry and Fire protection (CAL FIRE).

Source Data Reference: Mann, M.L., Batllori, E., Moritz, M.A., Waller, E.K., Berck, P., Flint, A.L., Flint, L.E. and Dolfi, E., 2016. Incorporating anthropogenic influences into fire probability models: effects of human activity and climate change on fire activity in California. PloS one, 11(4), p.e0153589. Available at:

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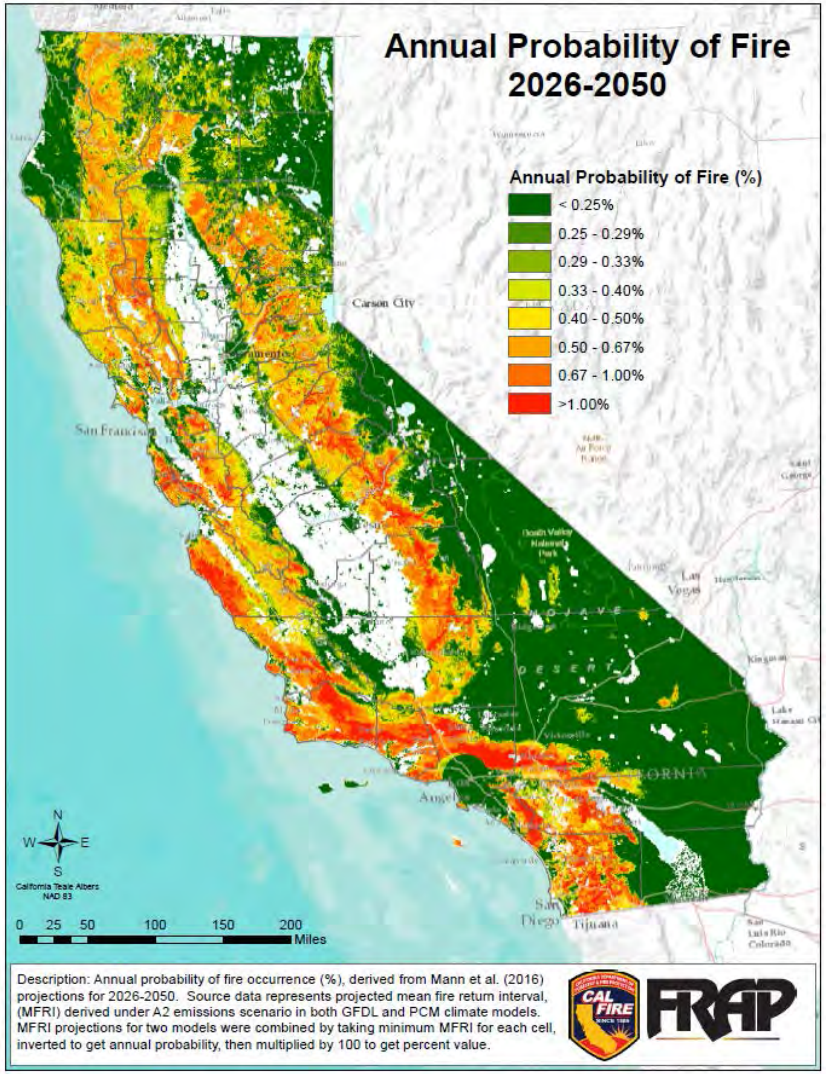
Annual Probability of Fire
2026-2050
Annual Probability of Fire (%)
< 0.25%
0.25 - 0.29%
0.29 - 0.33%
0.33 - 0.40%
0.40 - 0.50%
0.50 - 0.67%
0.67 - 1.00%
>1.00%
Carson City
San Francisco
Las Vegas
MOJAVE
DESERT
CALIFORNIA
San Diego
Tijuana
N
W
E
S
California Teale Albers
NAD 83
0 25 50 100 150 200
Miles
Description: Annual probability of fire occurrence (%), derived from Mann et al. (2016) projections for 2026-2050. Source data represents projected mean fire return interval, (MFRI) derived under A2 emissions scenario in both GFDL and PCM climate models. MFRI projections for two models were combined by taking minimum MFRI for each cell, inverted to get annual probability, then multiplied by 100 to get percent value.
CAL FIRE
FRAP

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FHSZ Maps

How building codes are applied…

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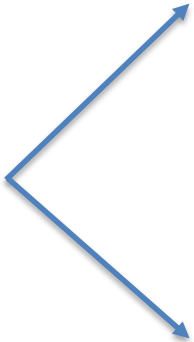
Scales of Planning Decisions

Future neighborhood siting/design…



Safety Element, General Plan

Local Fire Marshal/Planner Input

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What guidance exists?

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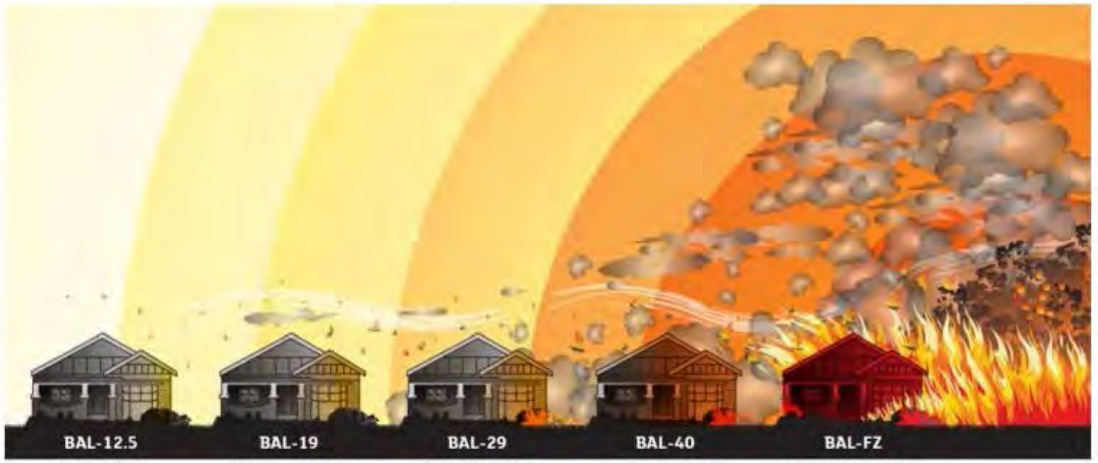
Australian Lessons & Context

> Figure 9: **BAL construction levels respond to different levels of risk.**

withstand different levels of bushfire attack, as illustrated below.



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