ECONOMIC FOOTPRINT OF CALIFORNIA WILDFIRES IN 2018

CMAS 2020

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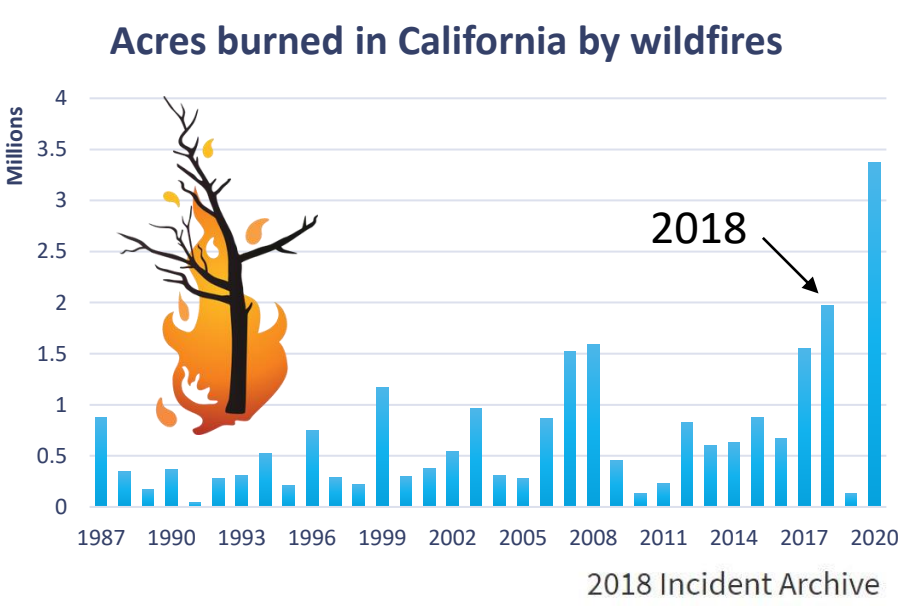
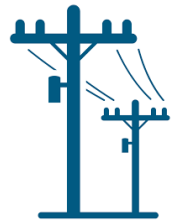
Wildfire in California: a Growing Threat



Climate

Lightning

Activities



Aging Grids

Size (Acres)
- 10
- 100
- 1,000
- 10,000
- 100,000
- county

A summary of all 2018 incidents, including those managed by CAL FIRE and other partner agencies.

1,975,086 Acres
Estimated Acres Burned

7,948 Incidents
Number of Wildfires

100 Fatalities
Confirmed Loss of Life

24,226 Structures
Structures Damaged or Destroyed

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Economic Footprint of Wildfire

Wildfire

Direct Damages

- Structure destruction
- Infrastructure damage
- Casualties

Indirect Damages

- Fire smoke health effects
- Transportation / labor supply interruption
- Upstream / downstream supply chain impacts

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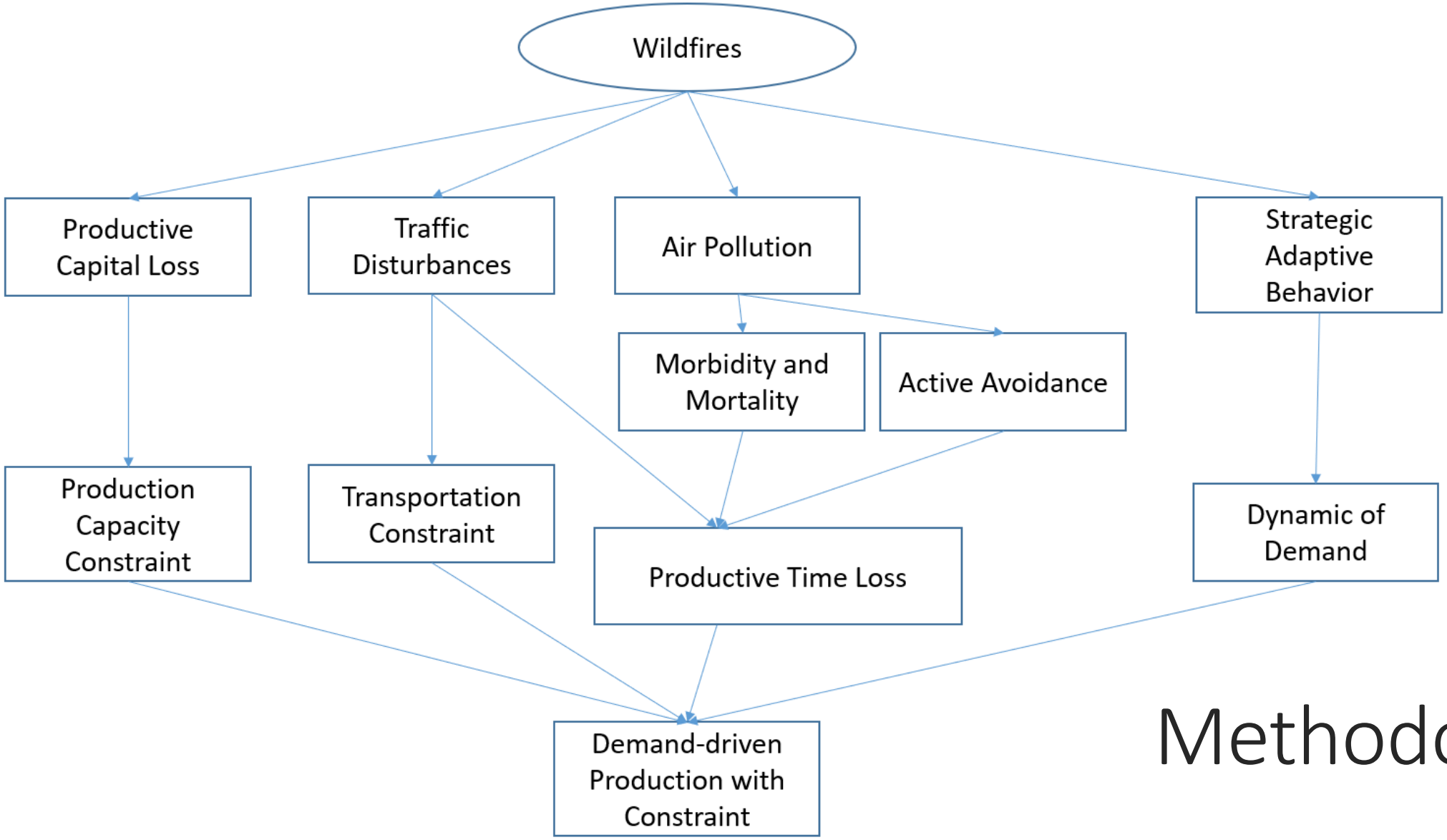

Methodology

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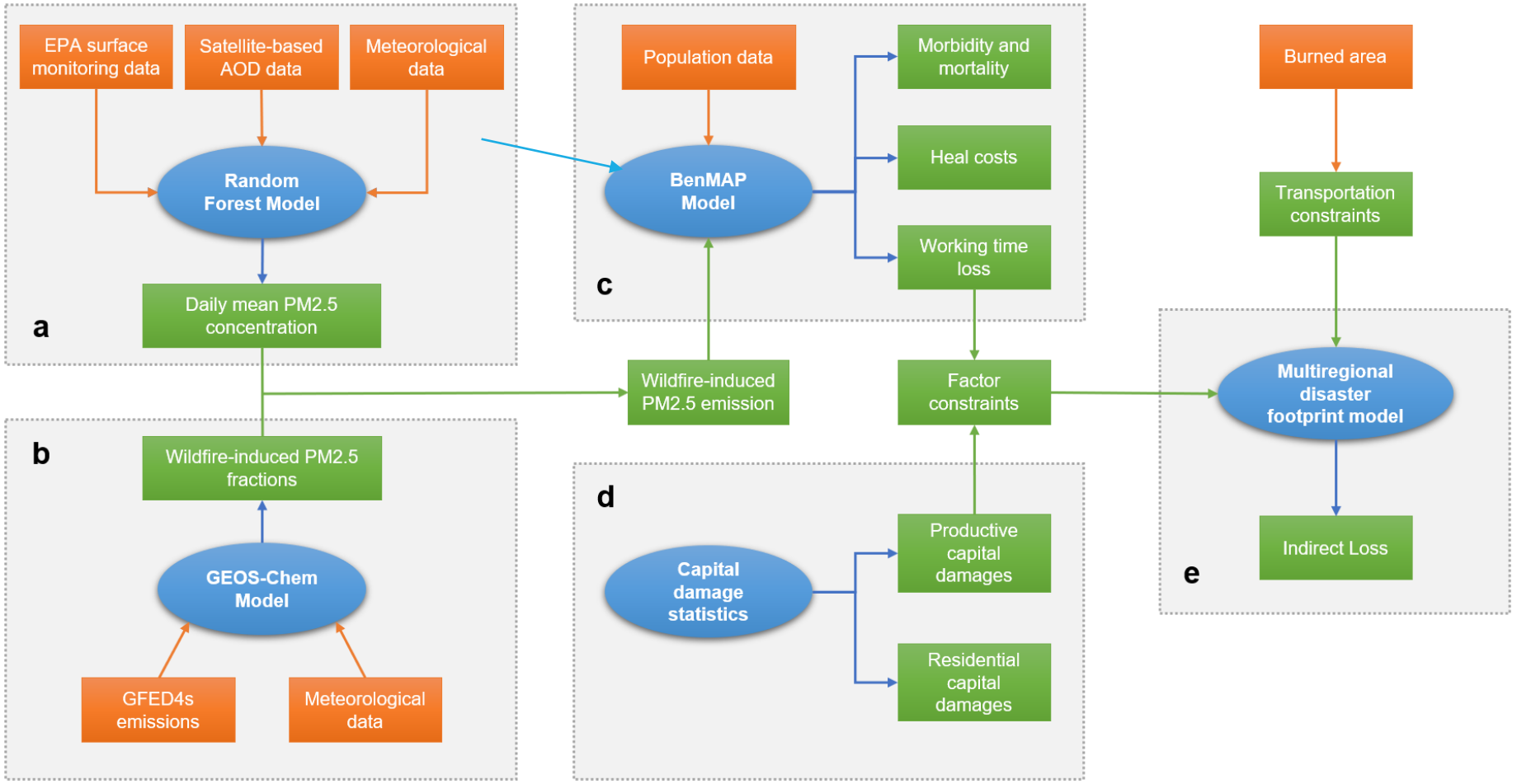
Modeling Framework



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Modeling Framework

EPA surface monitoring data

Satellite-based AOD data

Meteorological data

Random Forest Model

Daily mean PM2.5 concentration C_s

Wildfire-induced PM2.5 fractions

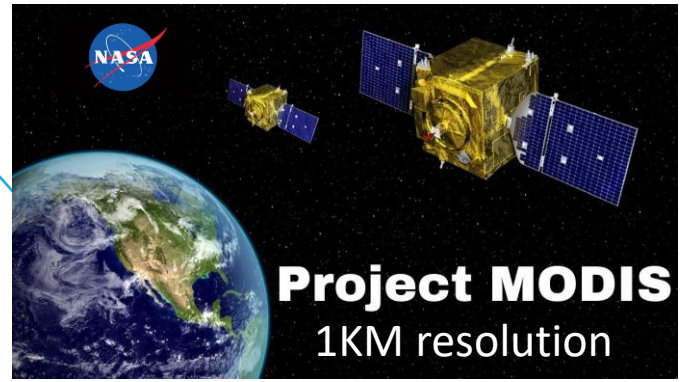
$$f_m = \frac{C_{nofire}}{C_{fire}}$$

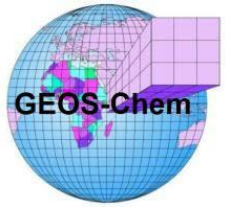
GEOS-Chem Model

GFED4s emissions

Meteorological data

Hu, X. *et al*. Estimating PM2.5 Concentrations in the Conterminous United States Using the Random Forest Approach. *Environmental Science & Technology* **51**, 6936-6944, doi:10.1021/acs.est.7b01210 (2017).





Scenario 1: No wildfire -> C_{nofire}
Scenario 2: With wildfire -> C_{fire}

12x12 KM resolution

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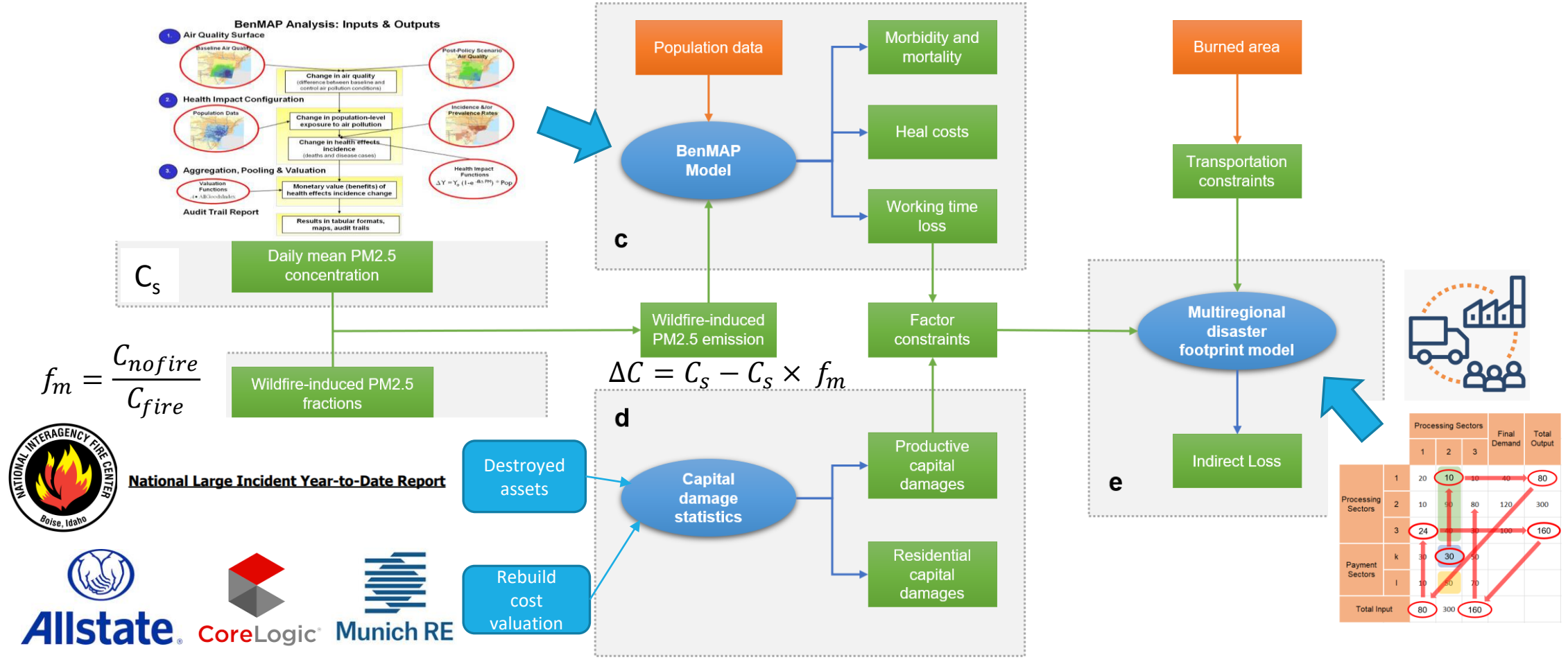
Modeling Framework



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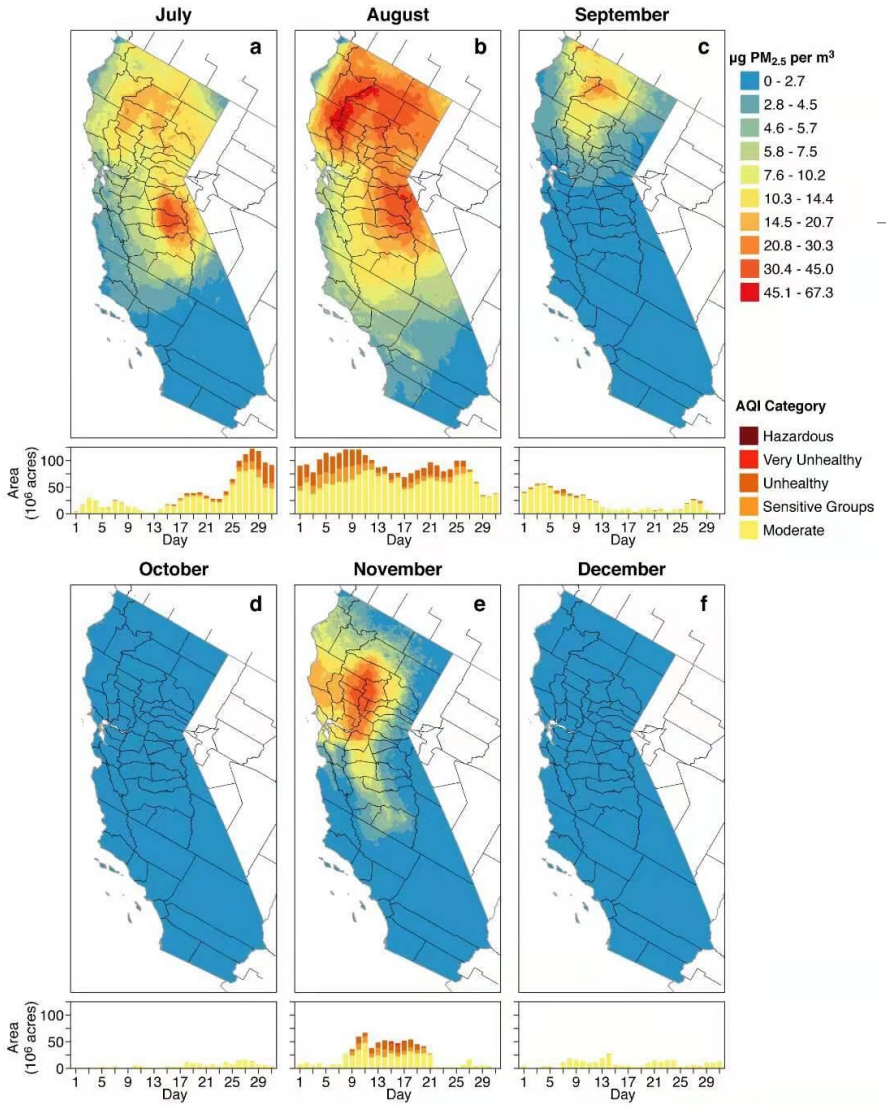

Air pollution

- Most major fire start in July or June and expanded in August.
- North California and Sierra Nevada religion is most impacted.
- July 30, unhealth air quality over 31% of the state's acreage.
- All the major fires begun prior to September ended in early September (except for the Delta fire).
- November 17, unhealthy or worse air quality over 39% of state's population.

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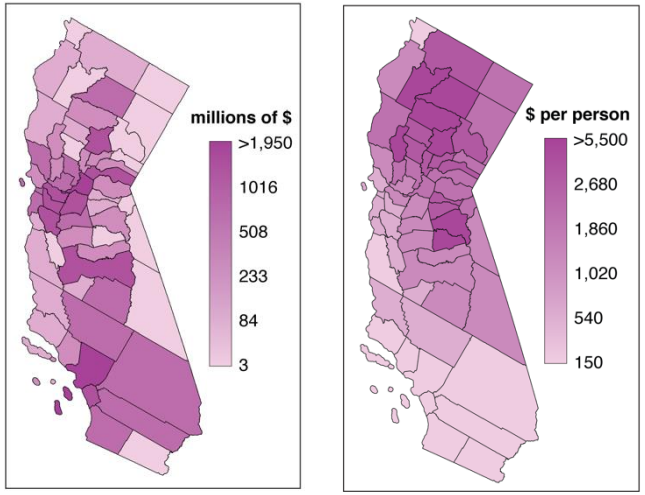
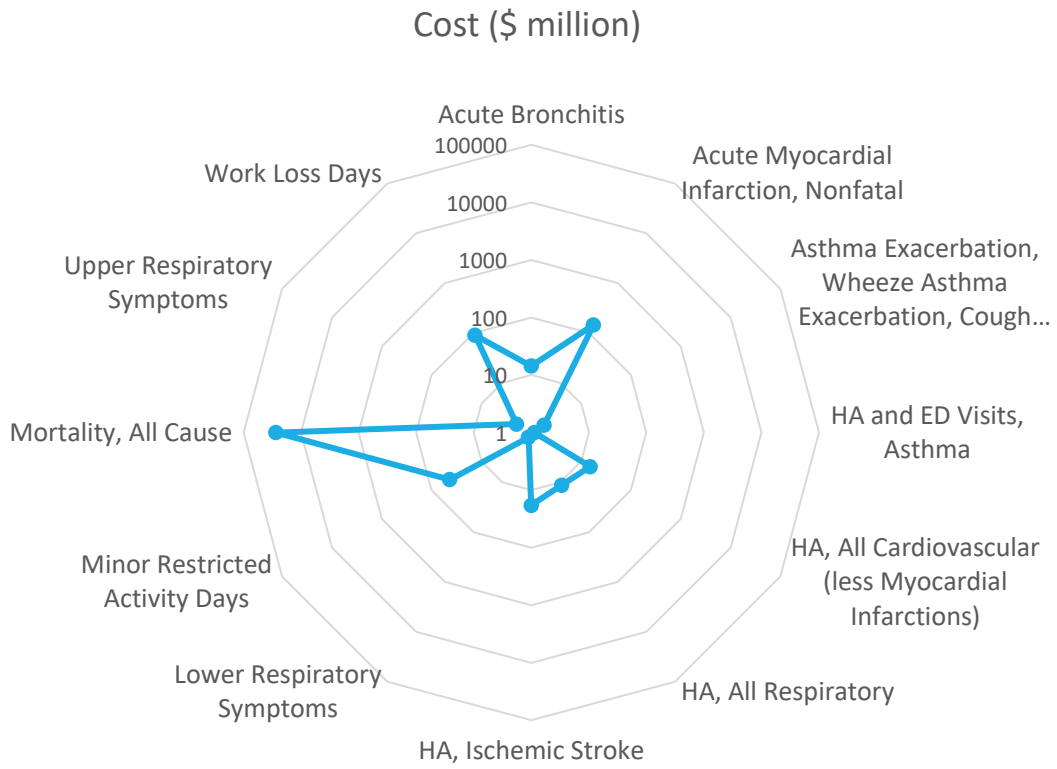
Health costs related to fire smoke

- Premature death due to air pollution: 3,652 > direct fire fatalities: 104 lives.
- Value of statistical life – loss of $27.2 billion.
- Cost of medical expense: $210 million.
- Cost of work time lost: $130 million.





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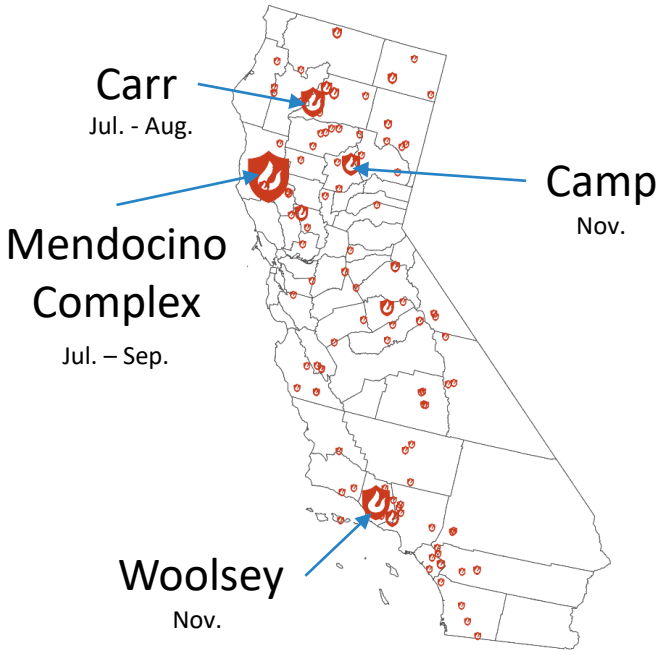

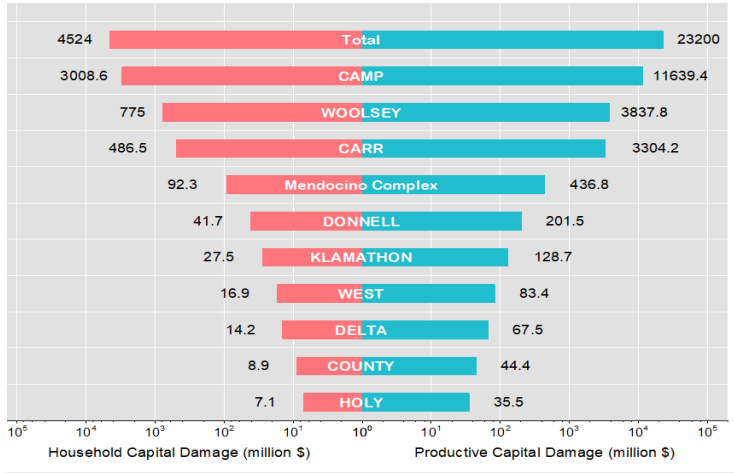

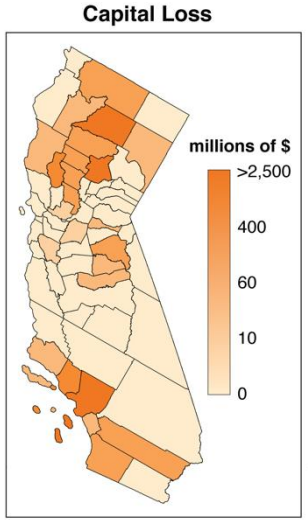

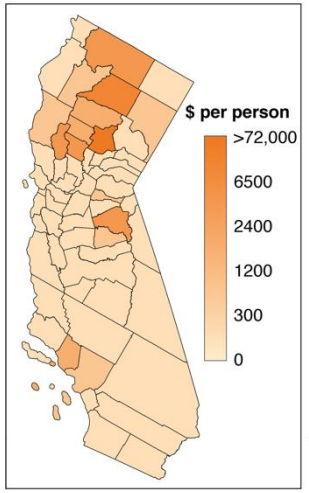

Capital losses

- Total: $27.7 billion.
- No. 1: Camp fire in Butte county ($14.6 billion; 53% of all capital losses).
- No. 2: Woolsey fire in Ventura and Los Angeles Counties ($4.6 billion).
- No. 3: Carr fire in Shasta and Trinity Counties ($3.8 billion).
- No. 4: Mendocino Complex has largest burned acres ($0.5 billion).

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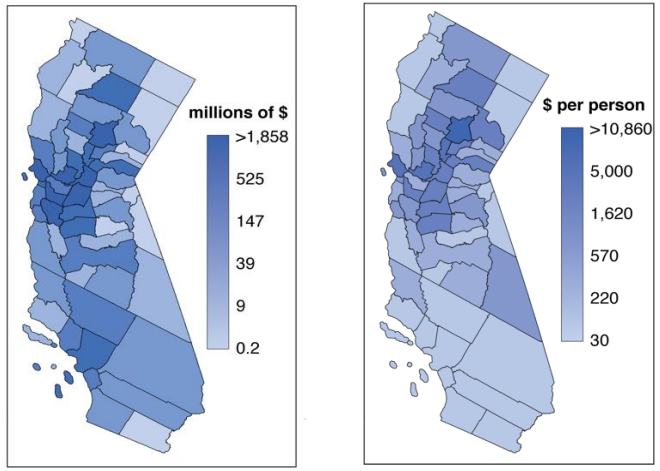
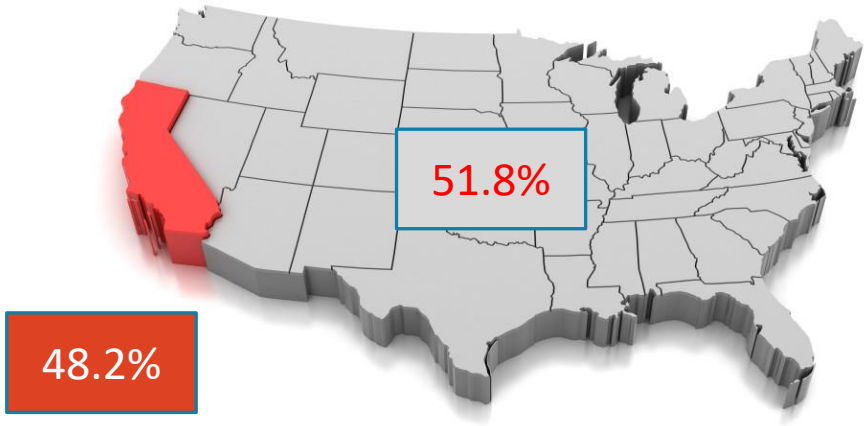
Indirect Losses

- Total losses in the US: $88.6 billion.
- Largest loss: Sacramento ($6.6 billion 8% GDP).
- Butte county $5.6 billion 47.4% GDP.



$88.6 billion 0.4% US GDP



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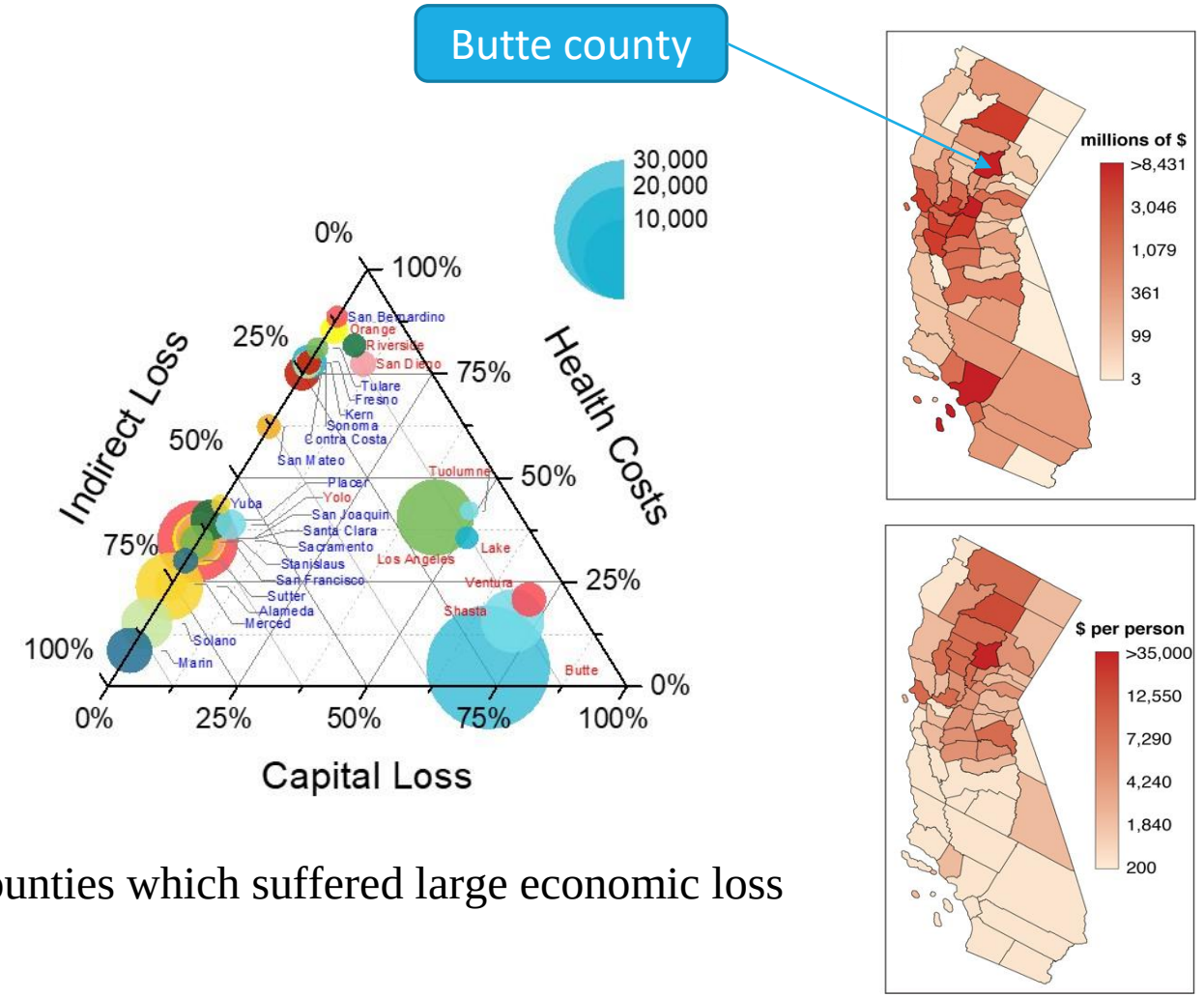

29 counties which suffered large economic loss

Economic footprint

- Total damages: $148.5 billion (1.5% GDP).
- Capital 19%; Health 22%; Indirect 59%.
- 31% of total losses were outside of California.
- Total losses were largest in Butte county ($23.2 billion), followed by Sacramento and Los Angeles counties ($10.1 and $9.1 billion, respectively.
- Per capita losses highlight areas with relatively low populations but large losses.

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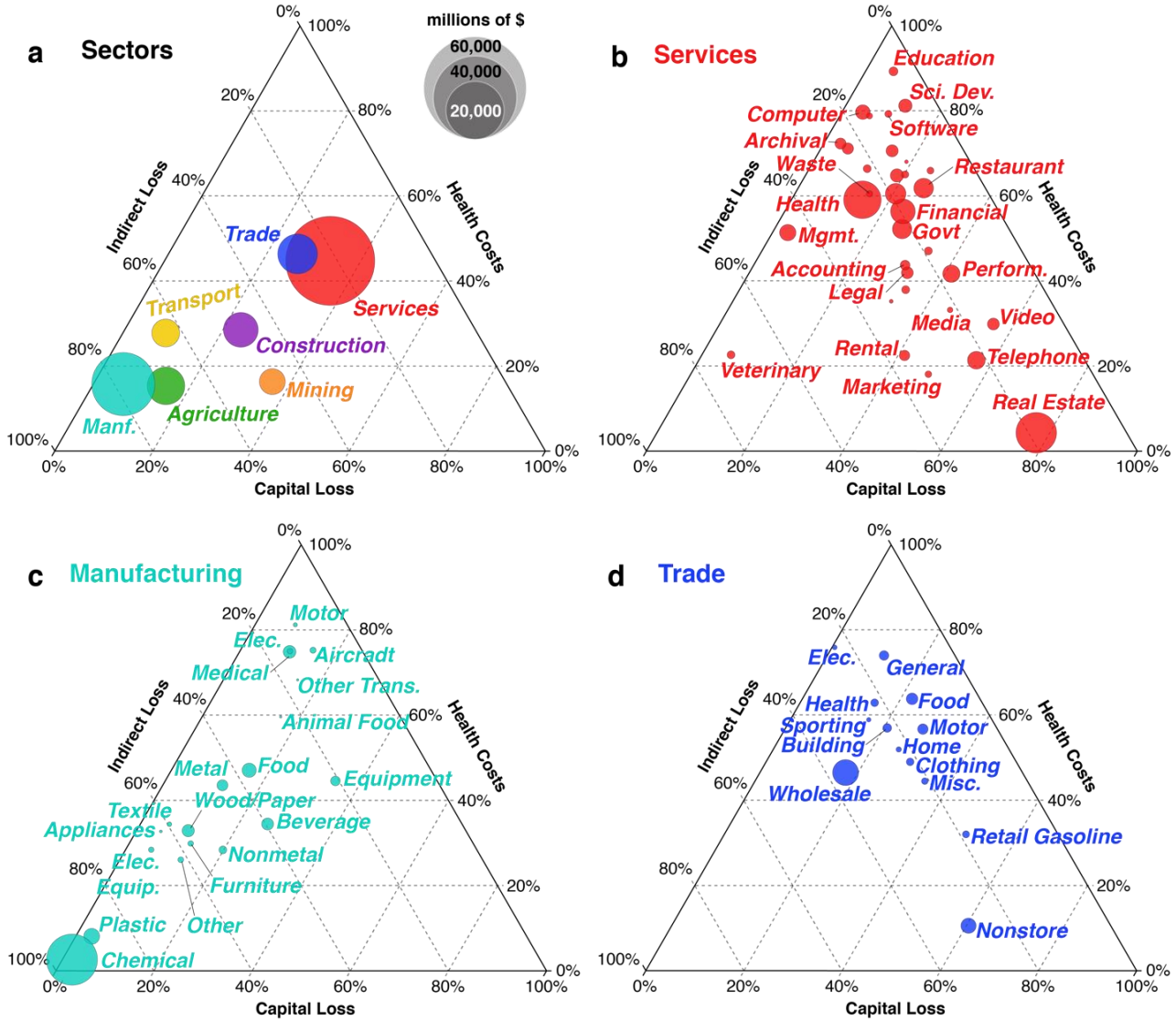

Economic footprint- Sectors

- Service industry: $44.4 billion (45%).
  - Health: 45%.
  - Capital 34%.
  - Indirect:21%.
  - Real Estate: $9.3 billion (77% of capital).
- Manufacturing: $22.3 billion (23%).
  - Indirect: 78%.
  - Health: 16%.
  - Capital: 6%.
  - Chemical industry: 100% indirect (is the largest manufacturing sector in California).
- Trade: $12.1 billion (8%).

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Conclusion

- A **comprehensive assessment framework** of socio-economic externalities of wildfires.
- Direct capital losses: **$27.7 billion (~0.8% of the state GDP).**
- Health costs induced by fire pollutants account for $32.2 billion, **larger than direct capital losses.**
- **Indirect supply-chain losses** represent the largest part: $42.7 billion.
- **U.S. beyond California** also suffered considerable economic damages ($45.9 billion).
- **Uneven spatial and sectoral distribution** of losses means that the policy should have a different focus.

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Thank you!

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