A State on Fire: Effect of California Wildfire on Perceived Risks and Home Values

A Case Study of Santa Clarita Valley

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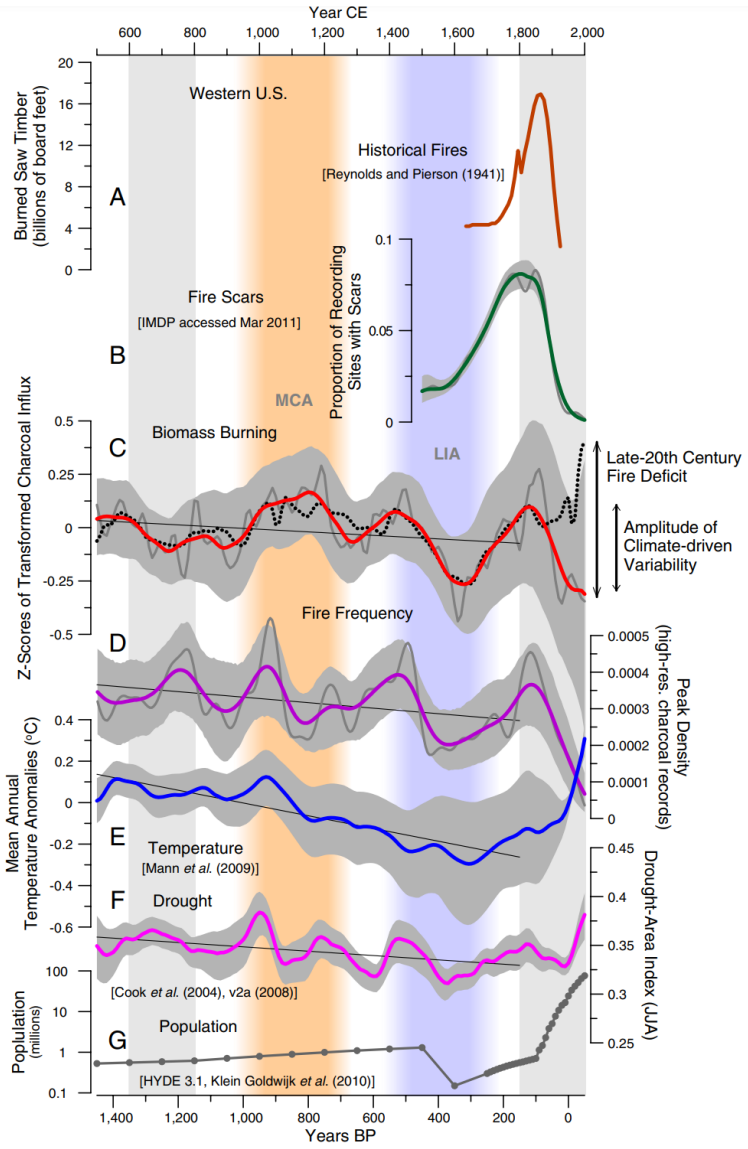


History of California Wildfires

- California Wildfires happen all the time pre-historically.
- Shaping California ecosystem for thousands of years.

- Entering the Anthropocene, we see a historical high of the temperature, deviating from its downward trend.
- While the fire frequency is at its trough in the natural cycle, the fire deficit has reached an all time high, posing growing risk of wildfires in the 21st century.

Why do CA wildfires gain so much attention recently?

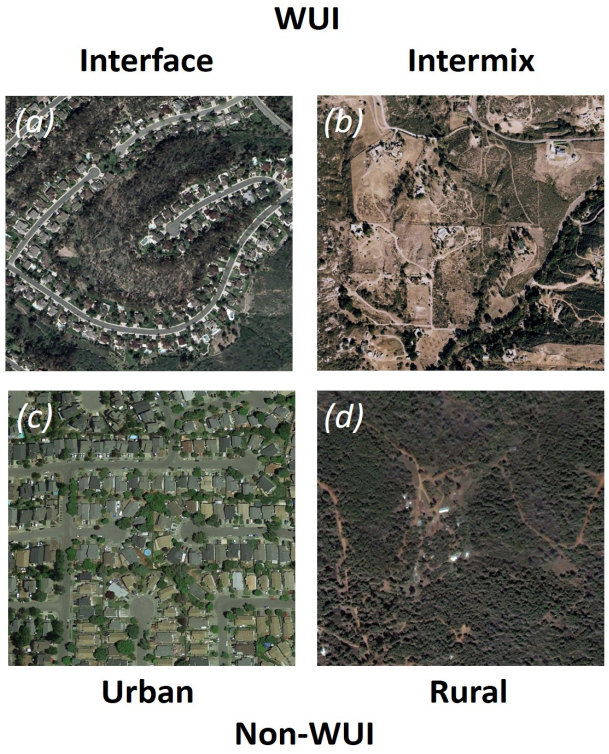
Top 10 Costliest Wildland Fires In The United States (1)

($ millions)

			Estimated insured loss	
Rank	Date	Name, Location	Dollars when occurred	In 2018 dollars (2)
1	Nov. 8-25, 2018	Camp Fire, CA (3)	$8,500-$10,500	$8,500-$10,500
2	Oct. 8-20, 2017	Tubbs Fire, CA (3)	7,500-9,700	7,700-9,900
3	Nov. 8-22, 2018	Woolsey Fire, CA (3)	3,000-5,000	3,000-5,000
4	Oct. 8-20, 2017	Atlas Fire, CA (3)	2,500-4,500	2,600-4,600
5	Dec 4-23, 2017	Thomas Fire, CA (3)	1,500-3,500	1,530-3,600
6	Oct. 20-21, 1991	Oakland Hills Fire, CA	1,700	2,851
7	Oct. 21-24, 2007	Witch Fire, CA	1,300	1,552
8	Jul. 23-Aug. 30, 2018	Carr Fire, CA (3)	1,000-1,500	1,000-1,500
9	Oct. 25-Nov. 4, 2003	Cedar Fire, CA	1,060	1,417
10	Oct. 25-Nov. 3, 2003	Old Fire, CA	975	1,304

- Into the 20th century, the frequency and severity of wildfires are growing as well as its impact on human lives.
- The recent fires have been record-setting.
- In 2018, the Camp fire devastated almost 160,000 acres, destroyed nearly 20,000 structures, and took away more than 80 lives.
- In 2020, the year we witness the largest wildfire season, had over 9000 fires, and burned over 4 million acres, which is almost half of the nation-wide figure of 8.6 million.

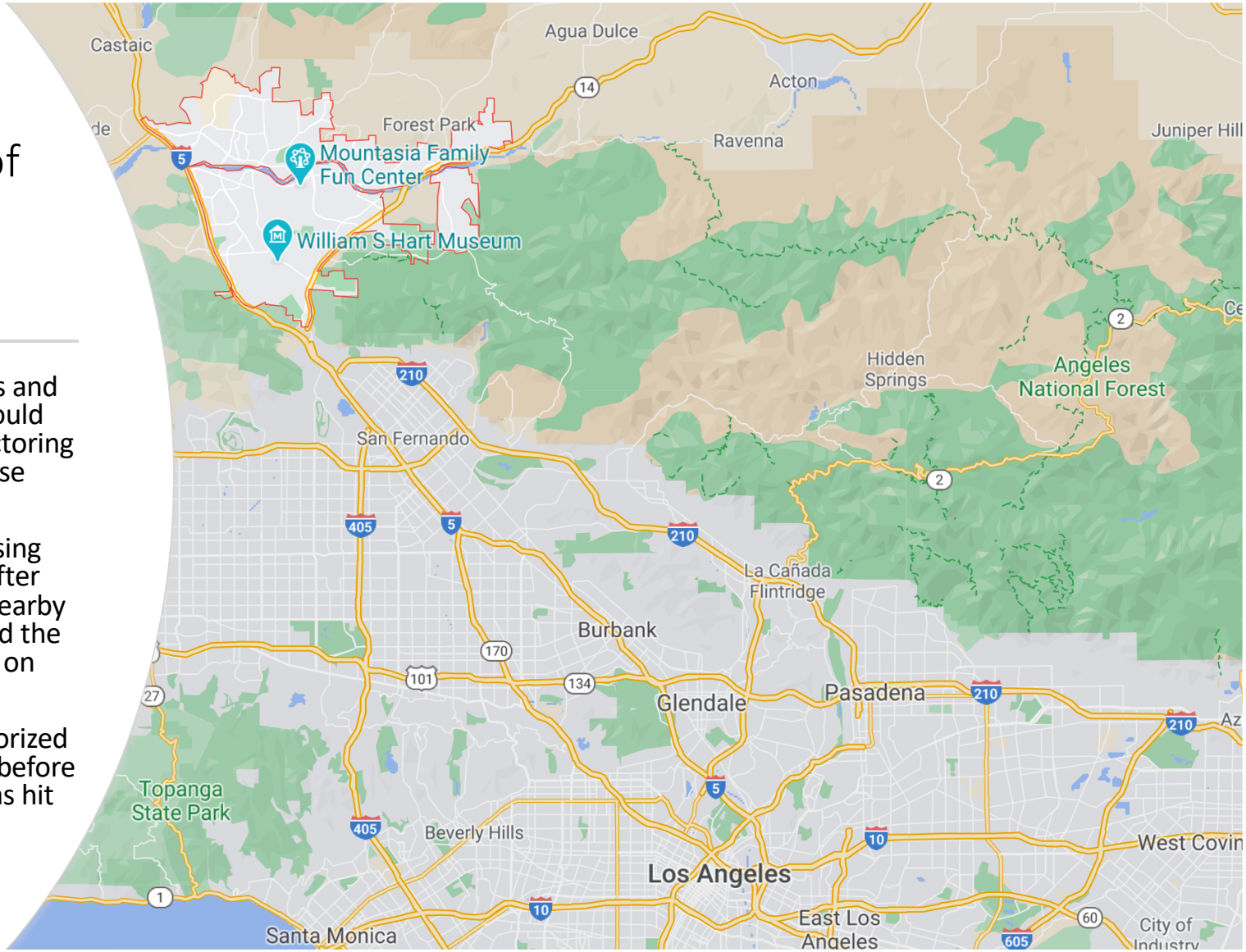
Why so severe and costly?



- The fire deficit accumulated in late 20th century and the fire suppression strategies provided excess fuels for the wildfires.
- Stronger and dryer winds driven by climate change help fire spread.
- Increasing human interaction with nature by moving to wildland-urban interface (WUI) put nearly 2 million properties in CA at risk --- more than all other states combined.
- WUI in the United States grew rapidly from 1990 to 2010 in terms of both number of new houses (from 30.8 to 43.4 million; 41% growth) and land area (from 581,000 to 770,000 km^2; 33% growth)

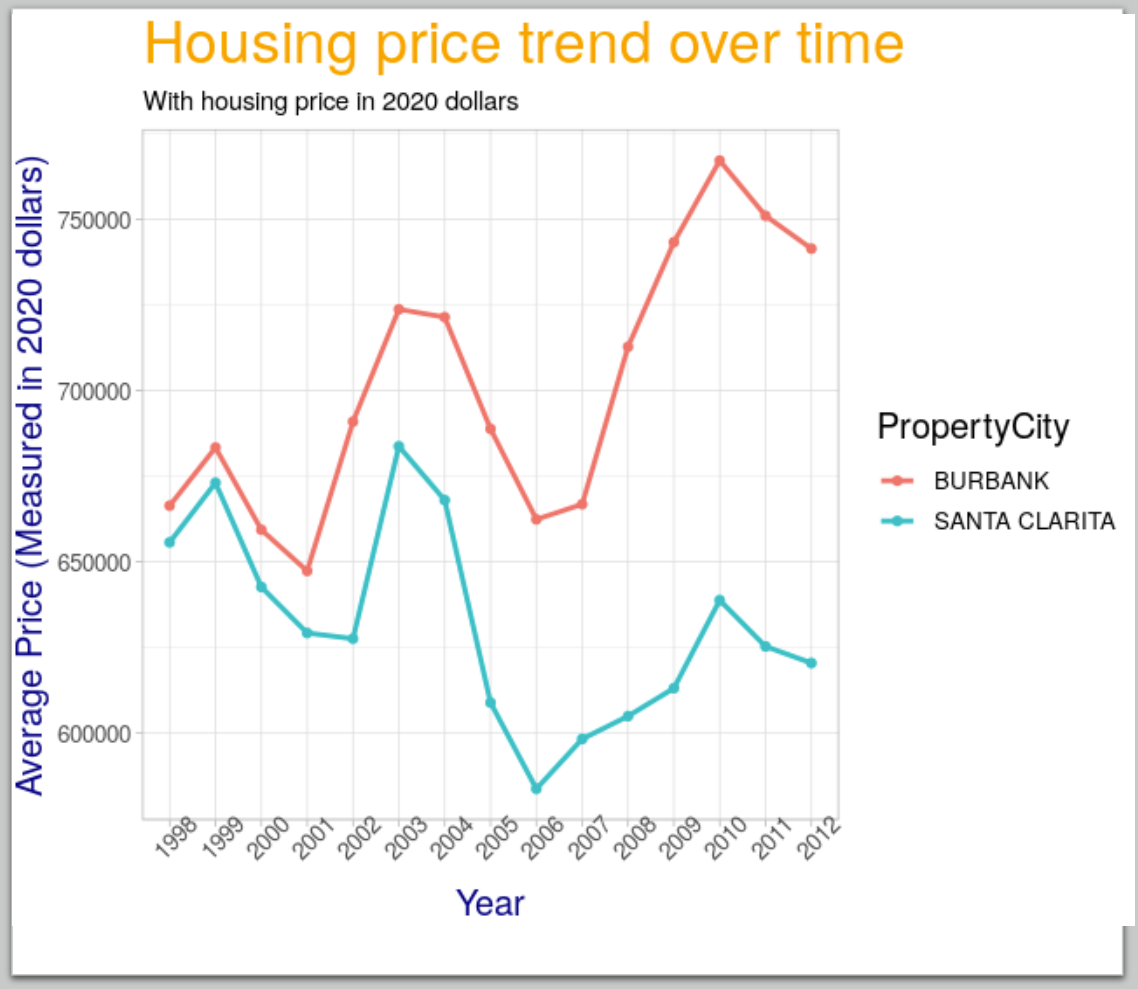
Are people aware of the fire risks?

- With the fires setting records and making the headlines, we would like to know if people are factoring in this risk when making house purchasing decisions.
- This project analyze the housing price trend in Santa Clarita after multiple fires compared to nearby city of Burbank to understand the effect of multiple fire events on perceived fire risks.
- Santa Clarita has been categorized as a rapidly developing WUI before the time of the study and was hit by multiple fires.



Data & Research Method

- The housing transaction data with house characteristics and sales information is acquired from Zillow. And the fire facts are acquired from CALFire.
- The study uses a difference-in-differences research method that compares if the fire leads to a differential trend in the trajectory of housing prices in the treatment group (Santa Clarita) compared to the control group (Burbank).
- Santa Clarita has experienced multiple fires during the timeframe of the study (1998 – 2012), which makes it perfect to study the evolution of people's perceived fire risks.
- 2003: Simi fire
- 2004: Foothill fire
- 2007: Buckweed and Magic fire
- 2008: Sayre fire



- Under the model assumption, the price trend in both the treatment and control group would have evolved similarly had it not been the fire.
- In the fire years: 2004, 2005, 2008, 2009, we see a flatter slope in the treatment group compared to the control group.

Model Result

The model regresses normalized sale price in 2020 dollars with covariates Lotsize, YearBuilt, Number of Bedrooms, Number of bathrooms, and the fires and interaction of treatment and fires.

In the linear model, we conclude holding other variables constant, Simi fire reduced housing price by on average $40,000, Buckweed and Magic fire reduced housing price by $48,000, Sayre fire reduced housing price by $31,800, all at the significance level of 1%.

In the log transformed model, we conclude holding other variables constant, Simi fire reduced housing price by on average 6%, Buckweed and Magic fire reduced housing price by 7%, Sayre fire reduced housing price by 3%, all at the significance level of 1%.

Foothill fire's effect on housing prices is relatively small and statistically insignificant.

	norprice2020		log(norprice2020)	
	(1)	(2)	(3)	(4)
LotSizeSquareFeet		-0.187***		-0.00000***
		(0.006)		(0.000)
YearBuilt		874.501***		0.001***
		(67.322)		(0.0001)
TotalBedrooms		64,670.830***		0.105***
		(1,354.823)		(0.002)
FullBath		23,440.850***		0.031***
		(1,827.027)		(0.003)
treatment1	-28,939.620***	-105,800.600***	-0.047***	-0.165***
	(4,723.873)	(4,655.067)	(0.007)	(0.007)
Simi	37,628.260***	44,618.910***	0.059***	0.071***
	(11,180.570)	(9,724.162)	(0.017)	(0.015)
Foothill	-42,127.860***	-42,360.320***	-0.061***	-0.061***
	(11,310.900)	(9,837.970)	(0.017)	(0.015)
BuckweedMagic	32,095.680***	28,172.430***	0.047***	0.039***
	(9,006.496)	(8,054.947)	(0.014)	(0.012)
Sayre	42,123.370***	45,282.850***	0.057***	0.061***
	(8,716.357)	(7,837.023)	(0.013)	(0.012)
treatment1:Simi	-37,587.850***	-40,185.170***	-0.060***	-0.063***
	(12,540.400)	(10,905.940)	(0.019)	(0.016)
treatment1:Foothill	-793.614	10,423.430	-0.007	0.011
	(12,719.950)	(11,066.690)	(0.019)	(0.017)
treatment1:BuckweedMagic	-39,107.770***	-48,239.750***	-0.058***	-0.074***
	(10,583.110)	(9,408.610)	(0.016)	(0.014)
treatment1:Sayre	-20,072.380**	-31,789.830***	-0.020	-0.037***
	(10,240.380)	(9,152.560)	(0.016)	(0.014)
Constant	682,220.700***	-1,242,209.000***	13.396***	10.349***
	(4,060.433)	(130,742.700)	(0.006)	(0.197)
Observations	26,262	25,507	26,262	25,507
R^2	0.049	0.282	0.051	0.306
Adjusted R^2	0.049	0.282	0.050	0.306
Residual Std. Error	183,709.400 (df = 26252)	159,389.500 (df = 25493)	0.282 (df = 26252)	0.241 (df = 25493)
F Statistic	149.887*** (df = 9; 26252)	770.366*** (df = 13; 25493)	155.238*** (df = 9; 26252)	866.253*** (df = 13; 25493)
Note:				*p<0.1; **p<0.05; ***p<0.01

Test Validity of Model

To test that the treatment effect in not from the specification of the model, a placebo test is run with a fake treatment group (City of Pasadena).

The city of Pasadena is chosen as the fake treatment group is because it is not affected by the fires, and it is geographically close to the treatment and control group, and all located near WUI, which makes it a good counterfactual.

If the model is correct, then the placebo regression should not pick up any effect of the fire in the treatment group (the coefficient on the interaction terms should not be statistically different from 0).

From the regression table, we do see that the interaction terms have insignificant coefficients across all specifications, with an exception of Buckweek and Magic fire in model 2.

This increases the confidence that the model is correct.

Placebo Regression Test

	norprice2020		log(norprice2020)	
	(1)	(2)	(3)	(4)
LotSizeSquareFeet		-0.631***		-0.00000***
		(0.038)		(0.00000)
YearBuilt		-1,418.916***		-0.002***
		(95.216)		(0.0001)
TotalBedrooms		24,704.600***		0.033***
		(2,481.992)		(0.003)
FullBath		60,289.980***		0.060***
		(2,938.568)		(0.003)
treatment1	77,851.550***	71,853.350***	0.077***	0.071***
	(8,732.114)	(8,100.418)	(0.010)	(0.009)
Simi	20,938.680	42,290.770**	0.032	0.058***
	(17,754.170)	(16,453.100)	(0.020)	(0.018)
Foothill	-30,273.890*	-29,345.870*	-0.039**	-0.038**
	(17,967.140)	(16,651.420)	(0.020)	(0.019)
BuckweedMagic	26,602.750*	26,780.620*	0.037**	0.035**
	(14,495.940)	(13,740.320)	(0.016)	(0.015)
Sayre	52,086.010***	54,650.470***	0.063***	0.066***
	(13,944.940)	(13,285.140)	(0.015)	(0.015)
treatment1:Simi	-12,363.150	-17,423.140	-0.022	-0.028
	(22,830.760)	(21,160.400)	(0.025)	(0.024)
treatment1:Foothill	-24,626.560	-24,000.960	-0.020	-0.019
	(23,063.310)	(21,384.440)	(0.026)	(0.024)
treatment1:BuckweedMagic	25,794.340	31,566.460*	0.022	0.032
	(18,953.740)	(17,994.640)	(0.021)	(0.020)
treatment1:Sayre	13,871.170	-4,880.343	0.015	-0.007
	(18,196.560)	(17,425.660)	(0.020)	(0.019)
Constant	759,012.700***	3,342,481.000***	13.491***	16.723***
	(6,564.456)	(185,871.900)	(0.007)	(0.207)
Observations	17,273	16,424	17,273	16,424
R^2	0.032	0.156	0.032	0.161
Adjusted R^2	0.032	0.156	0.031	0.160
Residual Std. Error	296,928.300 (df = 17263)	273,781.500 (df = 16410)	0.330 (df = 17263)	0.305 (df = 16410)
F Statistic	63.768*** (df = 9; 17263)	233.871*** (df = 13; 16410)	62.624*** (df = 9; 17263)	241.577*** (df = 13; 16410)

Note: *p<0.1; **p<0.05; ***p<0.01

Conclusion

- From the study, we see that fires do have a negative effect on housing values. In the case study of Santa Clarita fires, the housing price drops on average by 5% after a severe fire.
- However, learning, and perceived risk adjustment is observed: after a severe fire, a smaller fire in the following year has no statistically significant effect on housing values, until a bigger or equally as big fire happens.
- The effect of the fire on housing prices is most significant in the following 1 or 2 years, after that, if there are no new fires, the housing price trend looks similar to the control group