Wildfire smoke impacts on indoor air quality assessed using crowdsourced data in California

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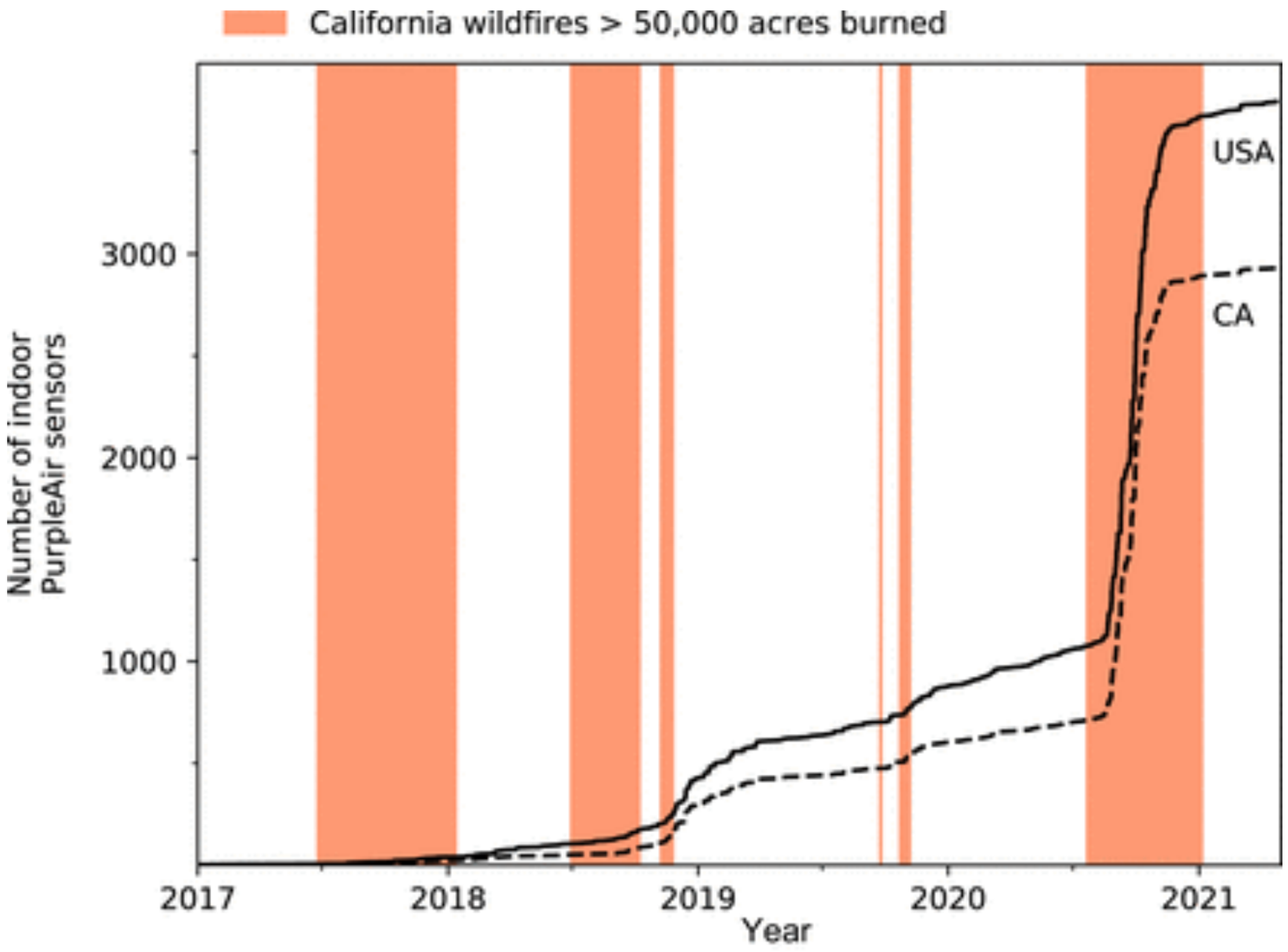
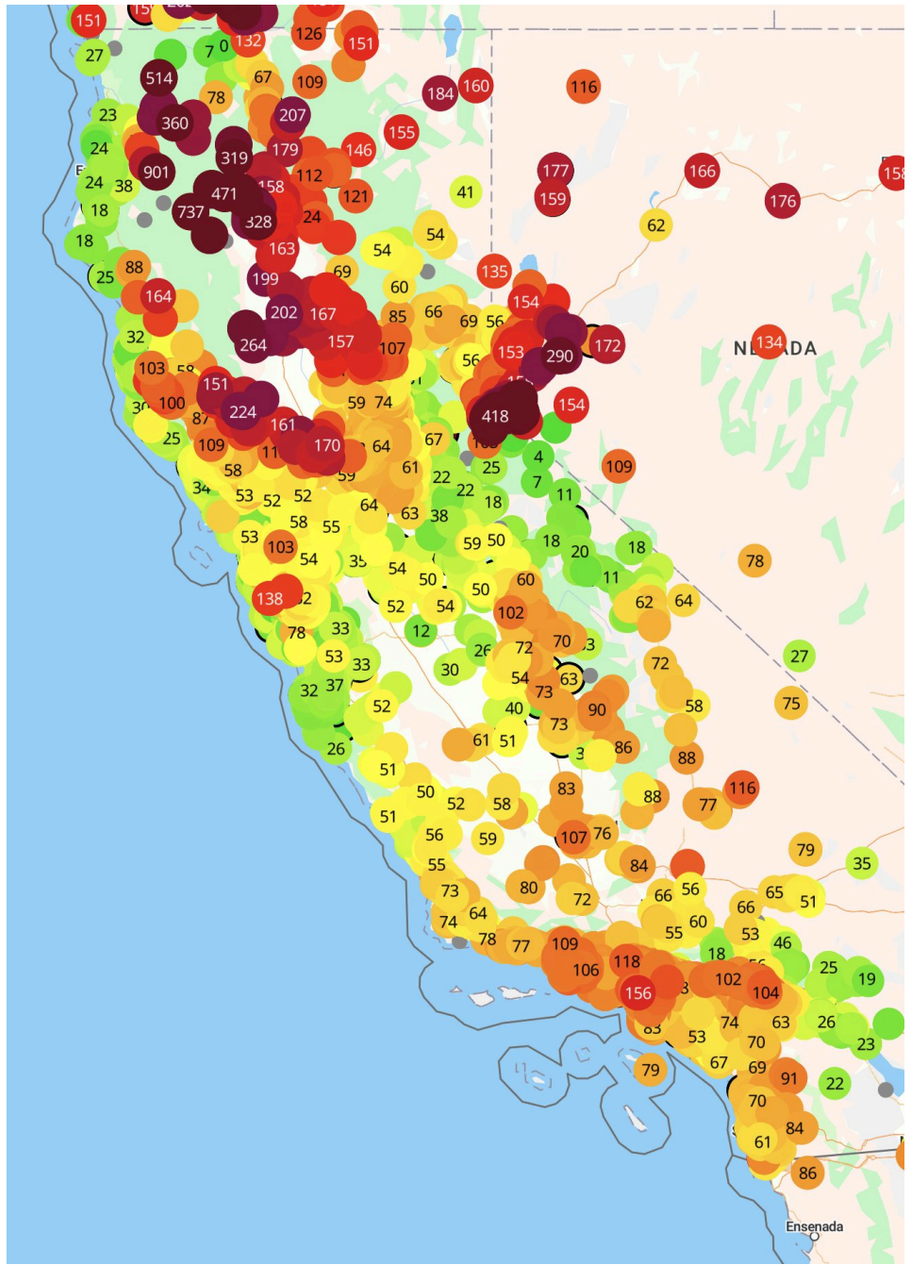
PurpleAir sensors adoption driven by wildfires?

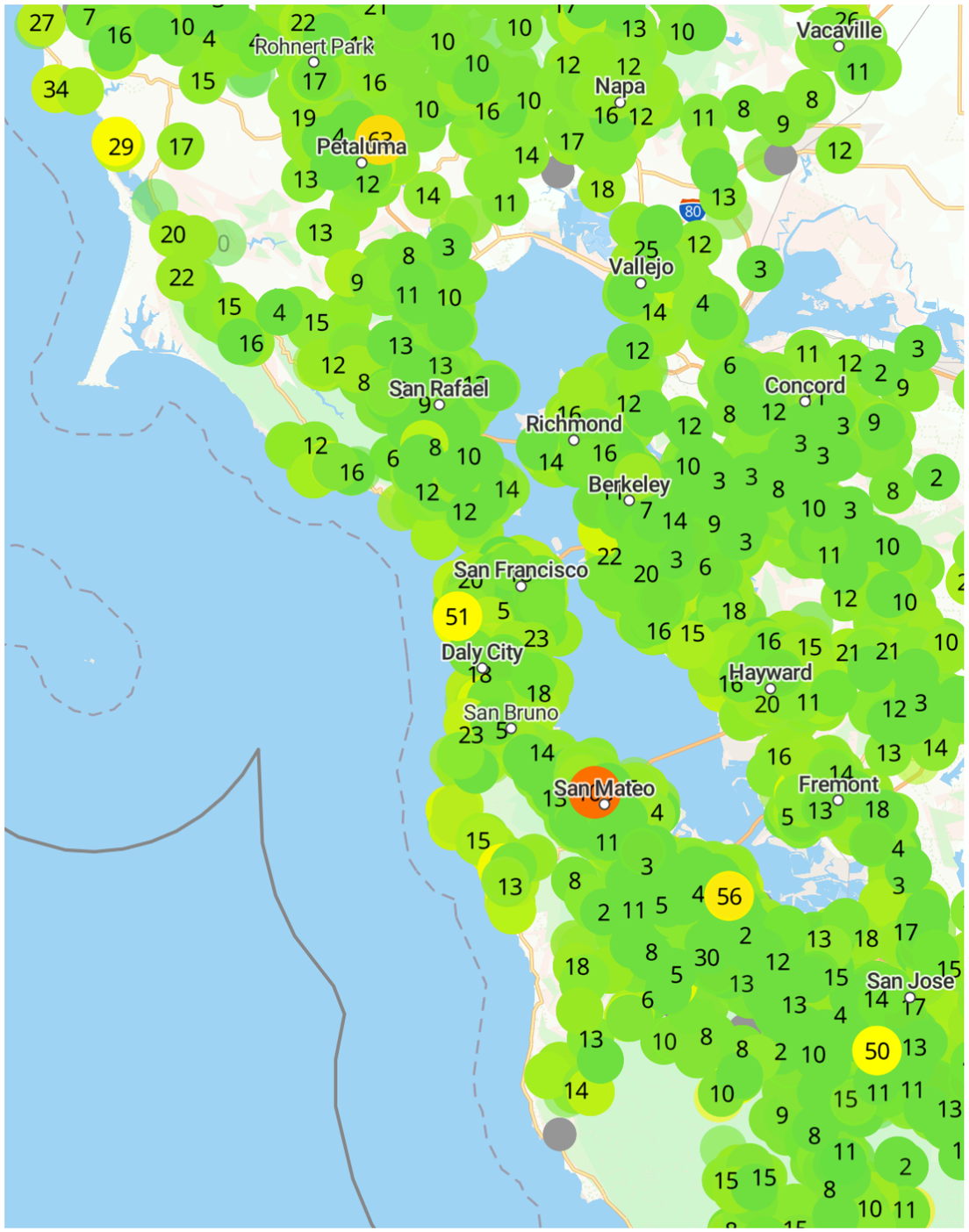


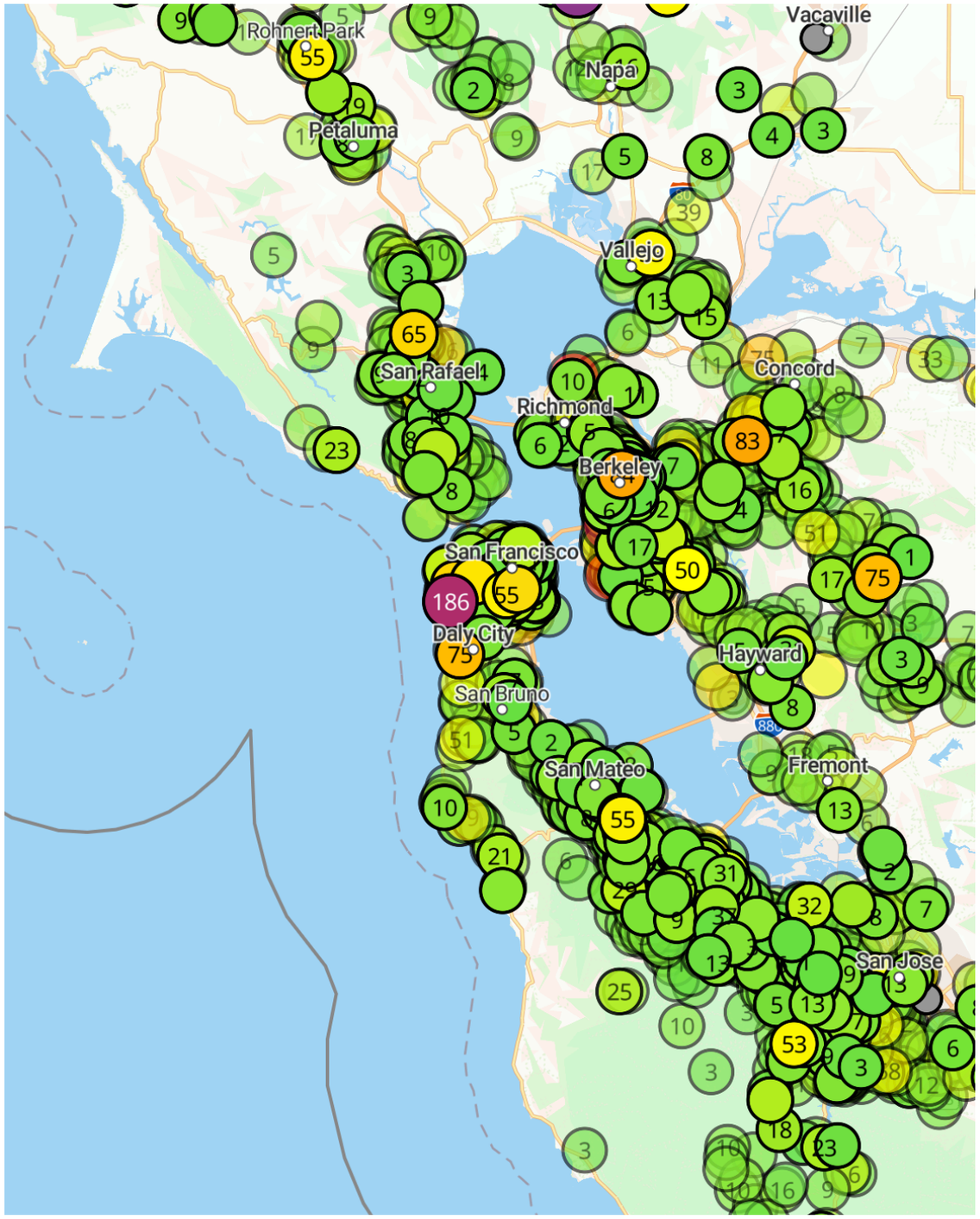


Deployed sensor count rapidly increases during wildfire events

Bay Area: the pointy end of the PA spear

57% of all global public PurpleAirs are in California: 69% outdoor, 31% indoor





Study design

How do indoor $PM_{2.5}$ levels respond to wildfire smoke?

- Identify 1400 indoor, public PurpleAir sensors in SF & LA areas

- Match each indoor sensor with closest outdoor PurpleAir sensor
- Develop / evaluate network calibration

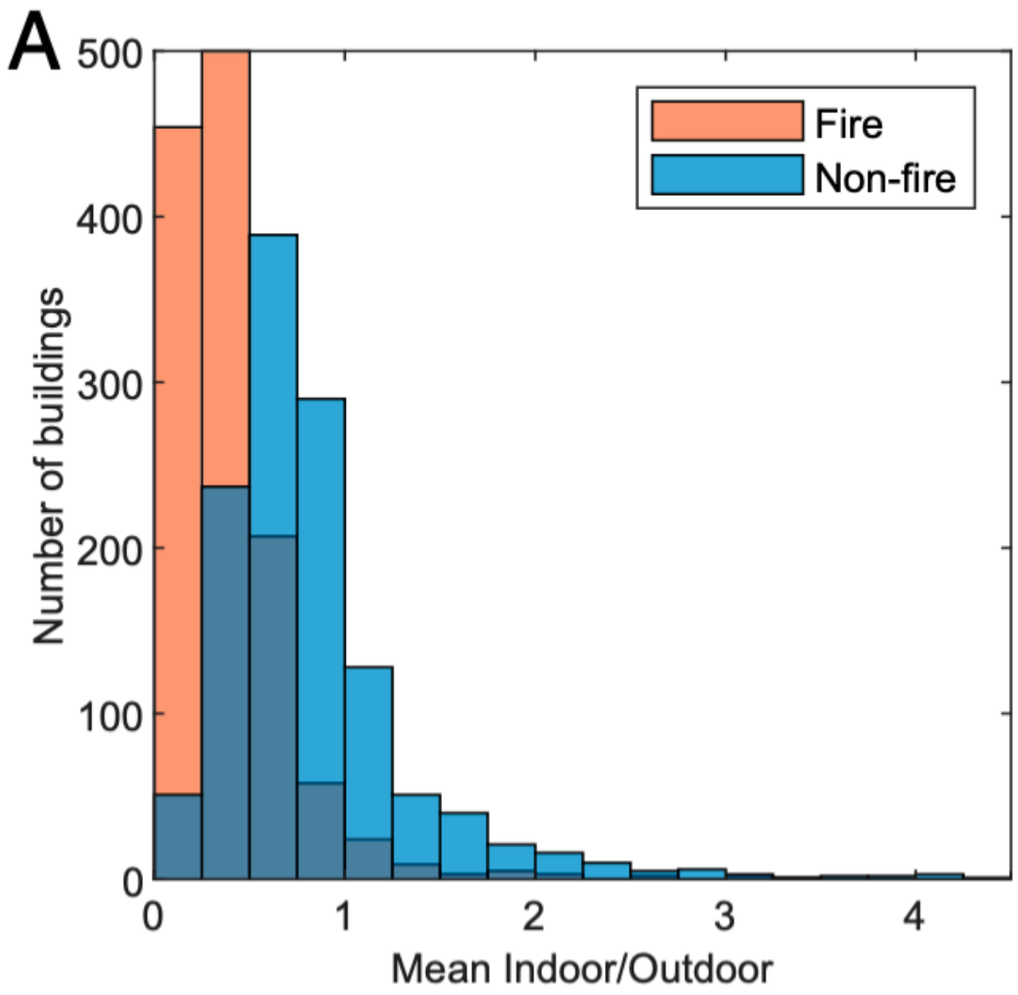
- Acquire building-level information from Zillow

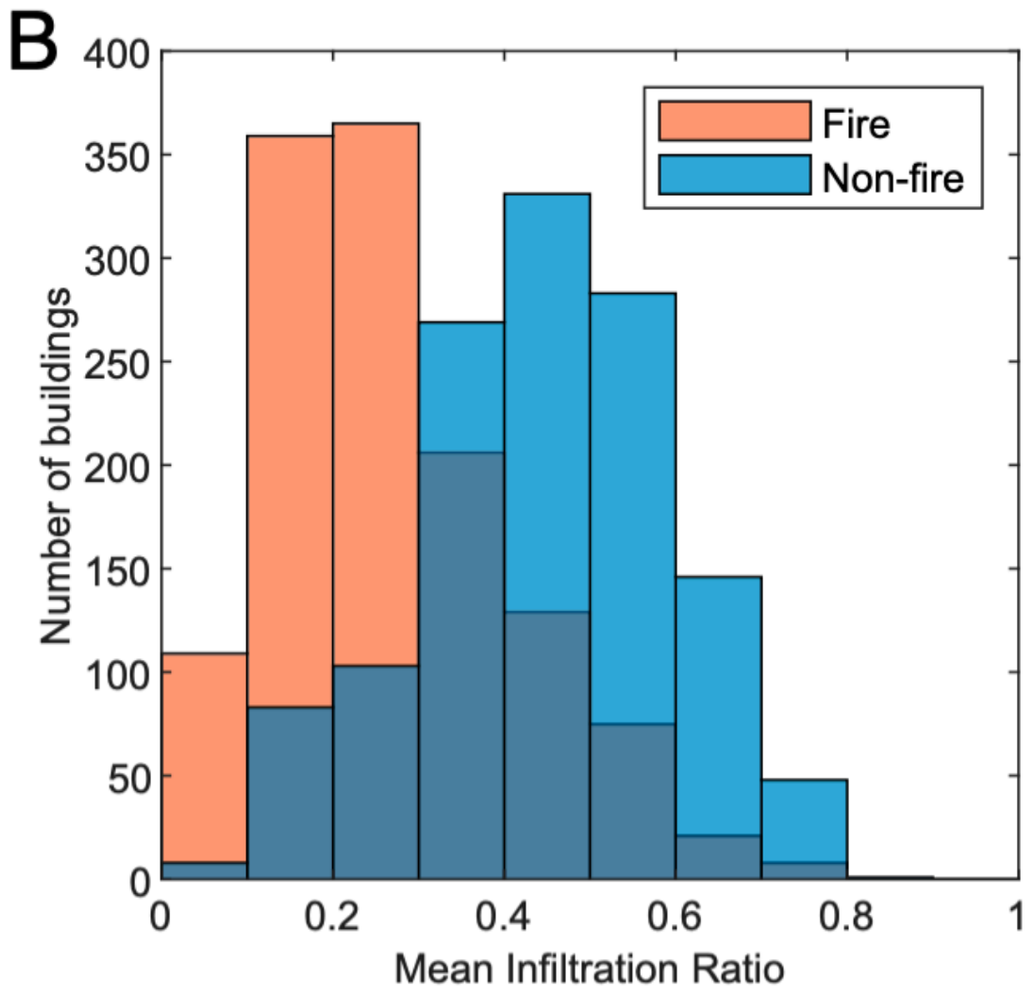
- Apply mass-balance model to estimate “infiltrated” $PM_{2.5}$: indoor particles of outdoor origin.

- Evaluate response of indoor $PM_{2.5}$ to wildfire smoke

Behavioral adaptation

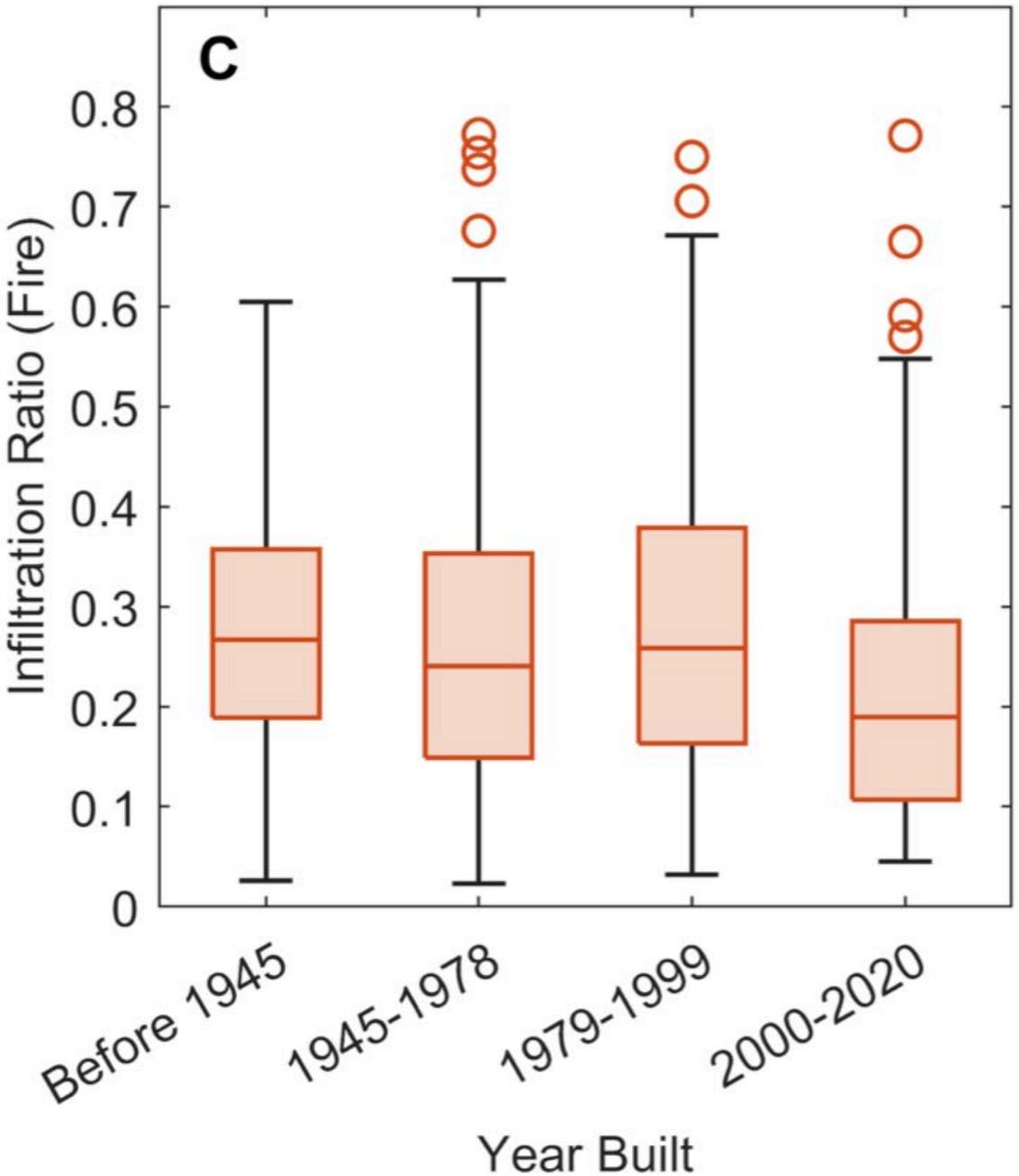
Infiltration of outdoor particles is lower on fire days.

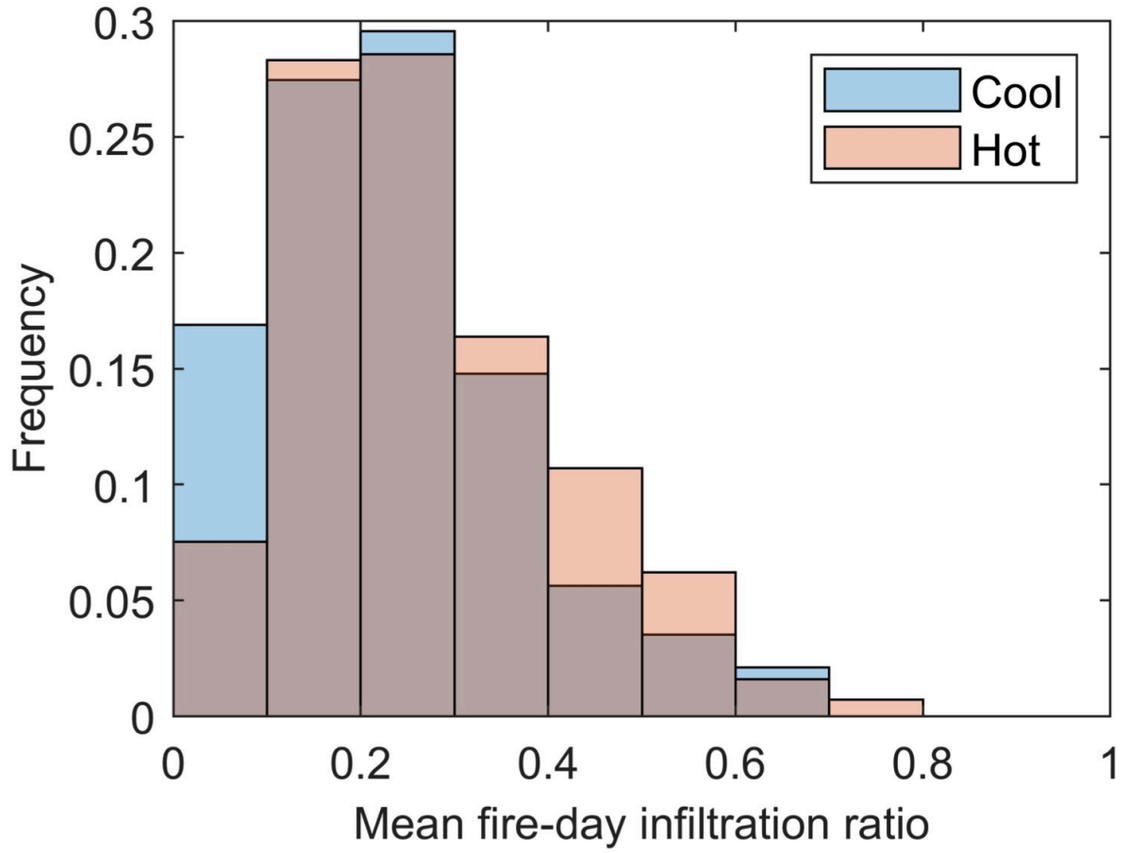




	Mean outdoor concentration ($\mu g \cdot m^{-3}$)	Mean indoor concentration ($\mu g \cdot m^{-3}$)		Indoor/outdoor ratio		Infiltration ratio	
	Mean ± SD	Mean ± SD	GM, GSD	Mean ± SD	GM, GSD	Mean ± SD	GM, GSD
Non-fire days	9.1 ± 4.0	4.1 ± 2.5	3.7, 1.6	0.90 ± 0.88	0.73, 1.8	0.45 ± 0.15	0.42, 1.5
Fire days	45.4 ± 17.0	11.1 ± 8.3	8.9, 2.0	0.41 ± 0.44	0.31, 2.1	0.27 ± 0.14	0.23, 1.8
Unhealthy days	61.2 ± 20.5	13.5 ± 10.6	10.3, 2.1	0.31 ± 0.42	0.23, 2.1	0.23 ± 0.14	0.19, 1.9

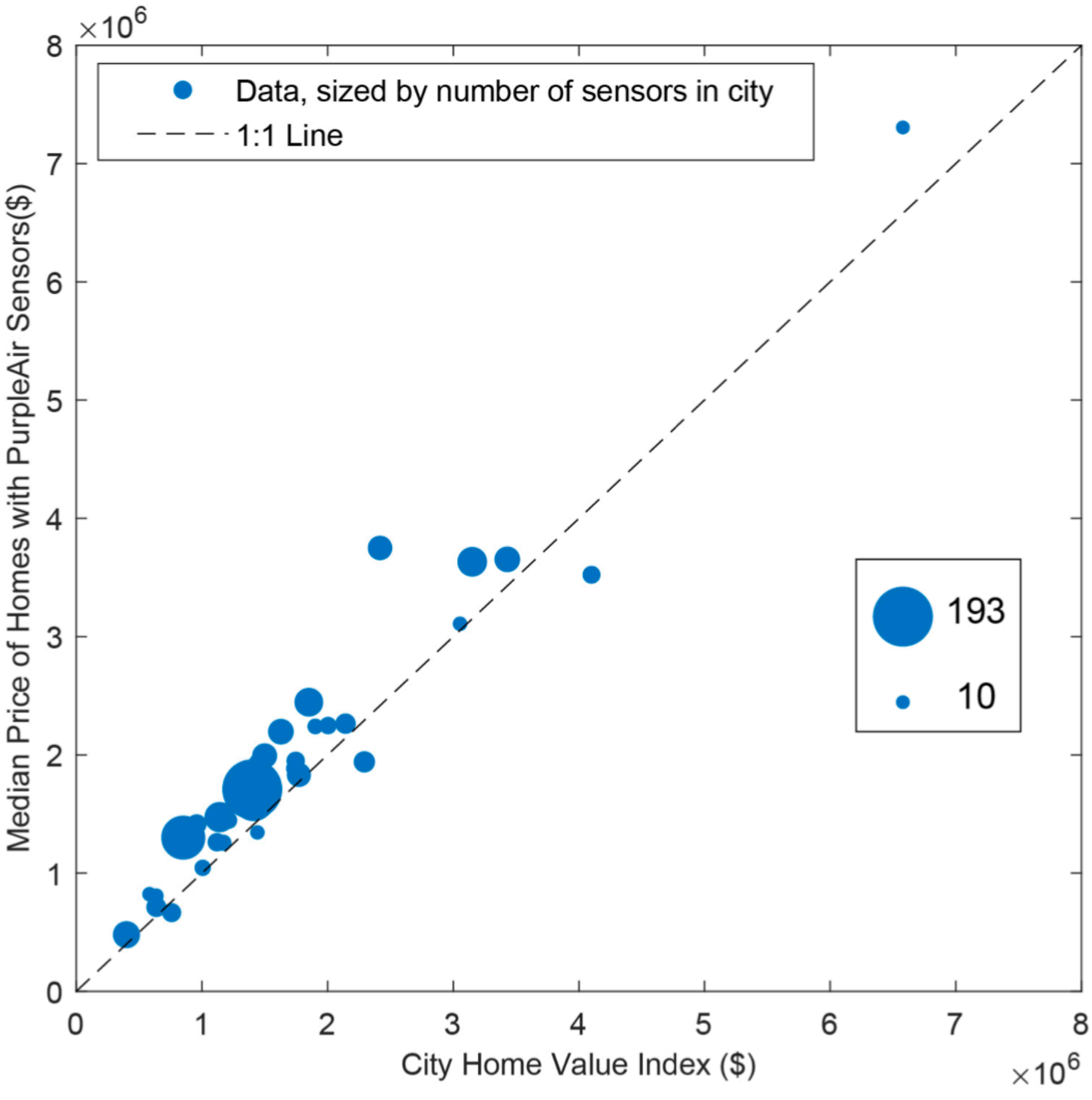
Housing characteristics





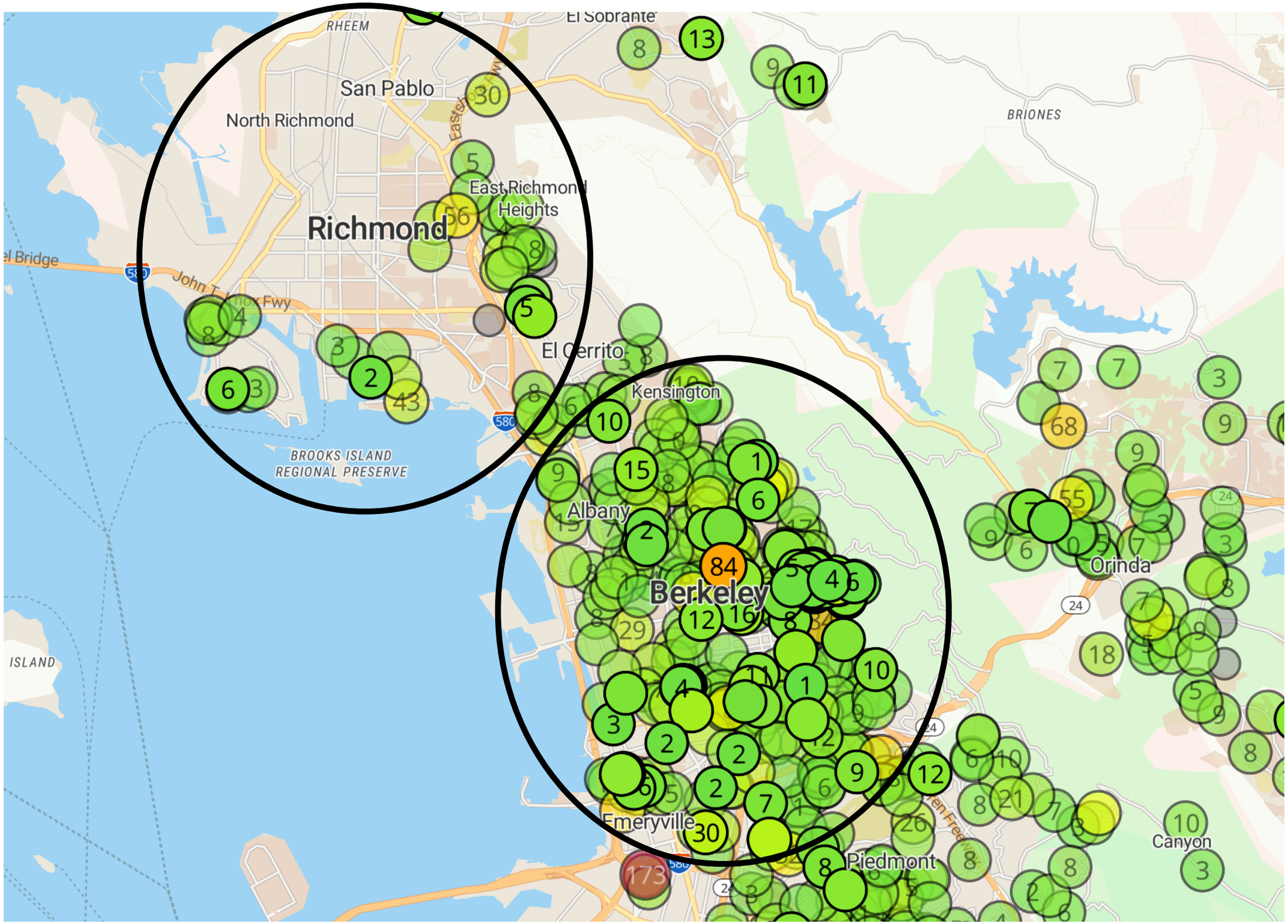
Newer homes and homes with A/C seem to have lower infiltration of wildfire smoke

Homes with PA sensors have higher average Zillow values



Behavior of PurpleAir owners is unlikely to be representative of broader population.

Indoor sensors: a tale of two cities



Key conclusions

- Buildings can and do effectively protect people from smoke.

- PurpleAir owners appear to undertake behavioral changes to reduce smoke infiltration into their homes.

- It would be extremely useful to have a more representative sample of indoor air quality with LCS.

- **Opinion:** the LCS community has insufficiently emphasized the opportunity to better understand *indoor exposures.* This is a real opportunity.