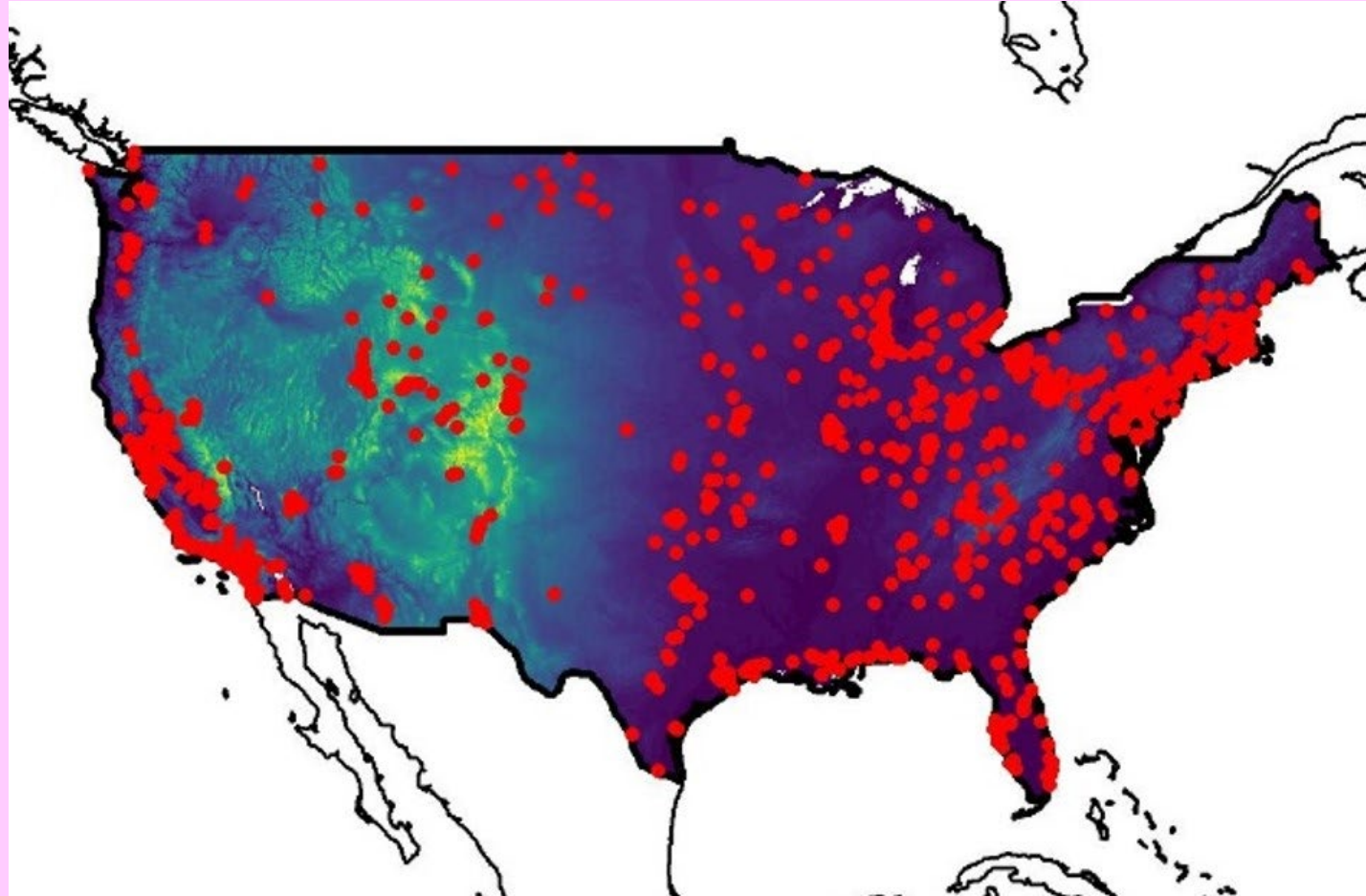
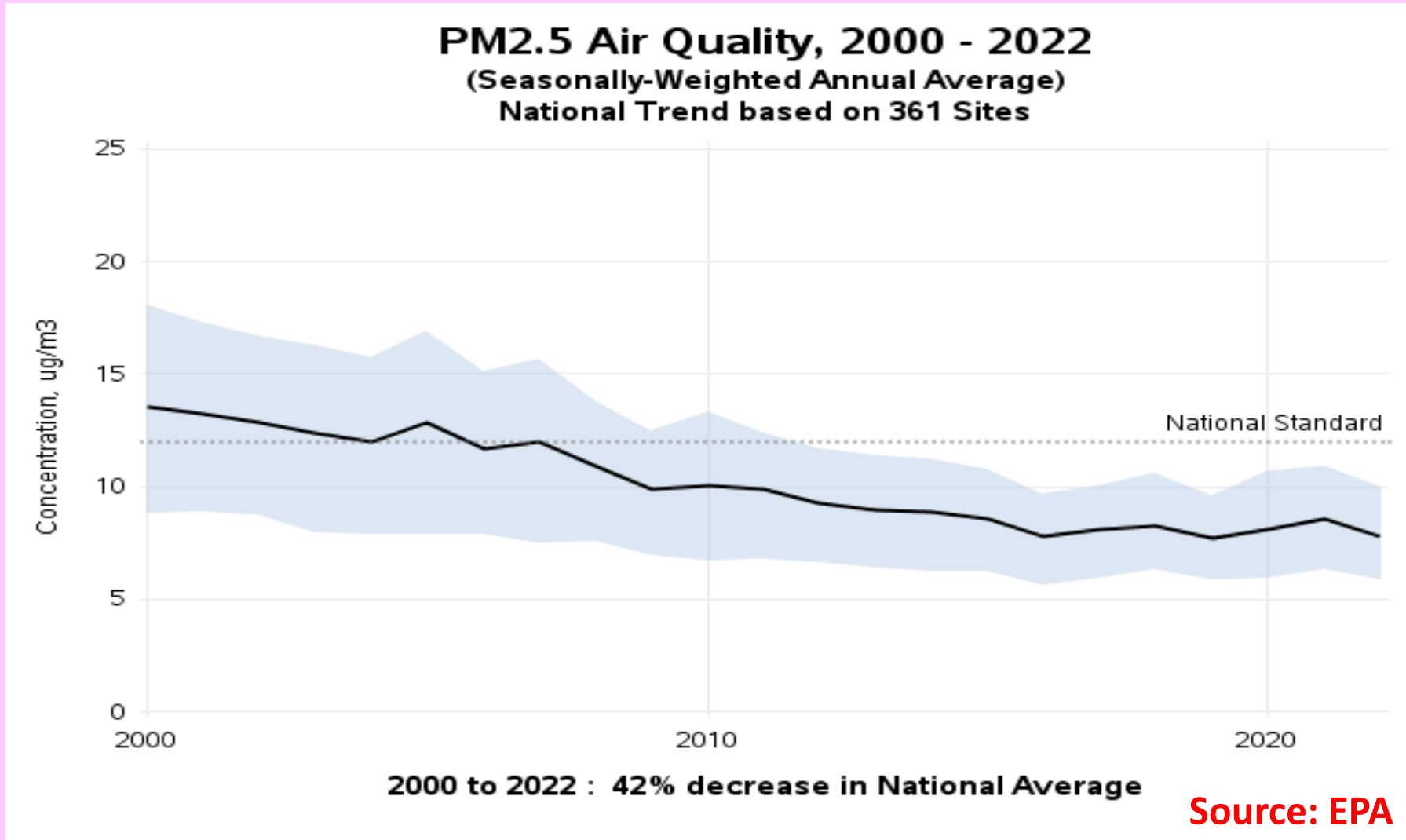


A framework to routinely identify and quantify $\text{PM}_{2.5}$ and O_3 from fires for the entire U.S.

Dan Jaffe, University of Washington



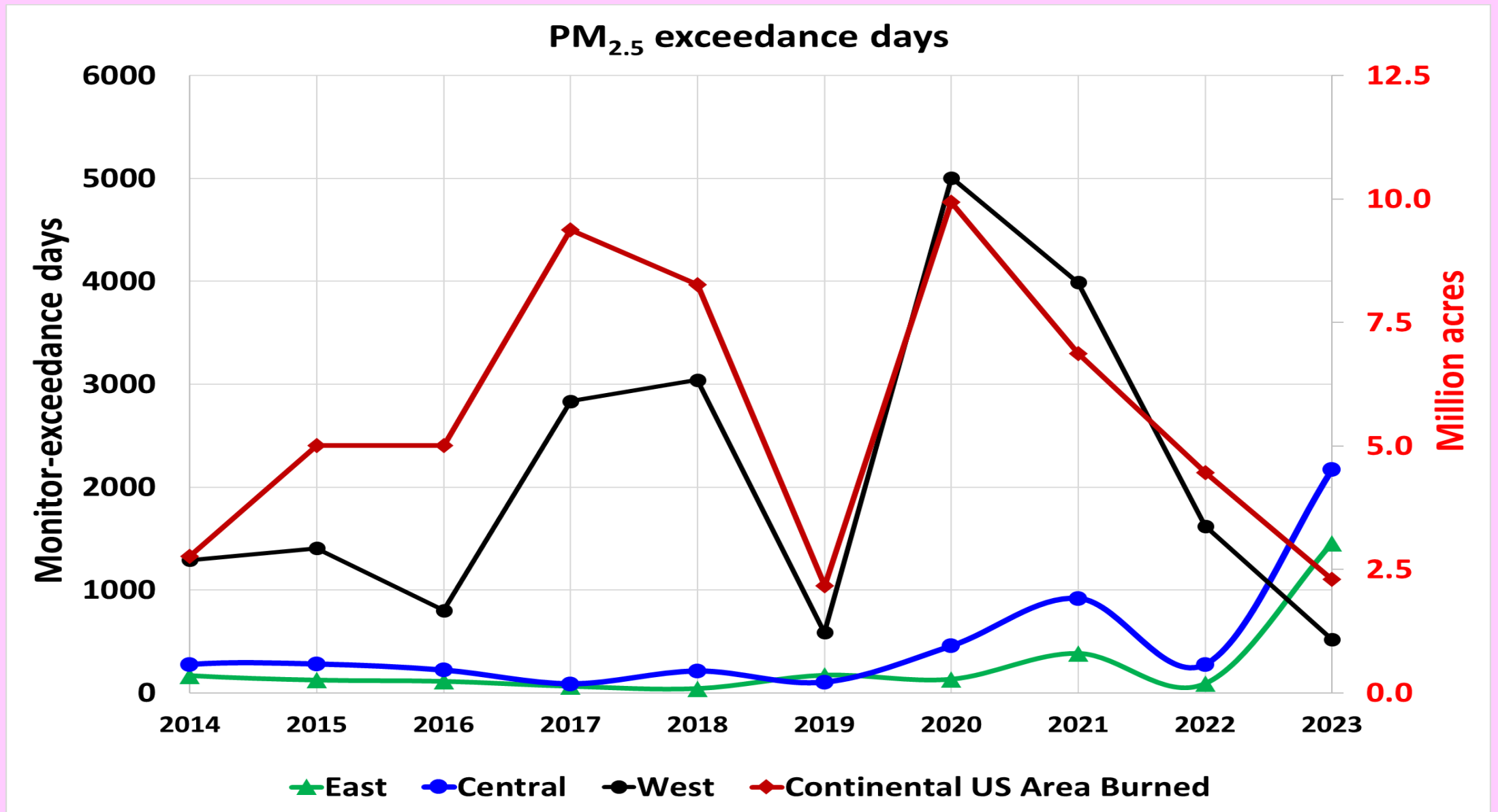
Success due to the CAA



This success is predicated on holding the polluter accountable.

What problems are we trying to solve?

- 1) Wildfires are now a major driver of exceedances of the PM_{2.5} and O₃ standards across the U.S.**
- 2) With new PM_{2.5} standard, the number of EE requests likely to significantly increase.**
- 3) Heavy workload on the states.**
- 4) Uncertainty as to what counts as a smoke exceedance.**

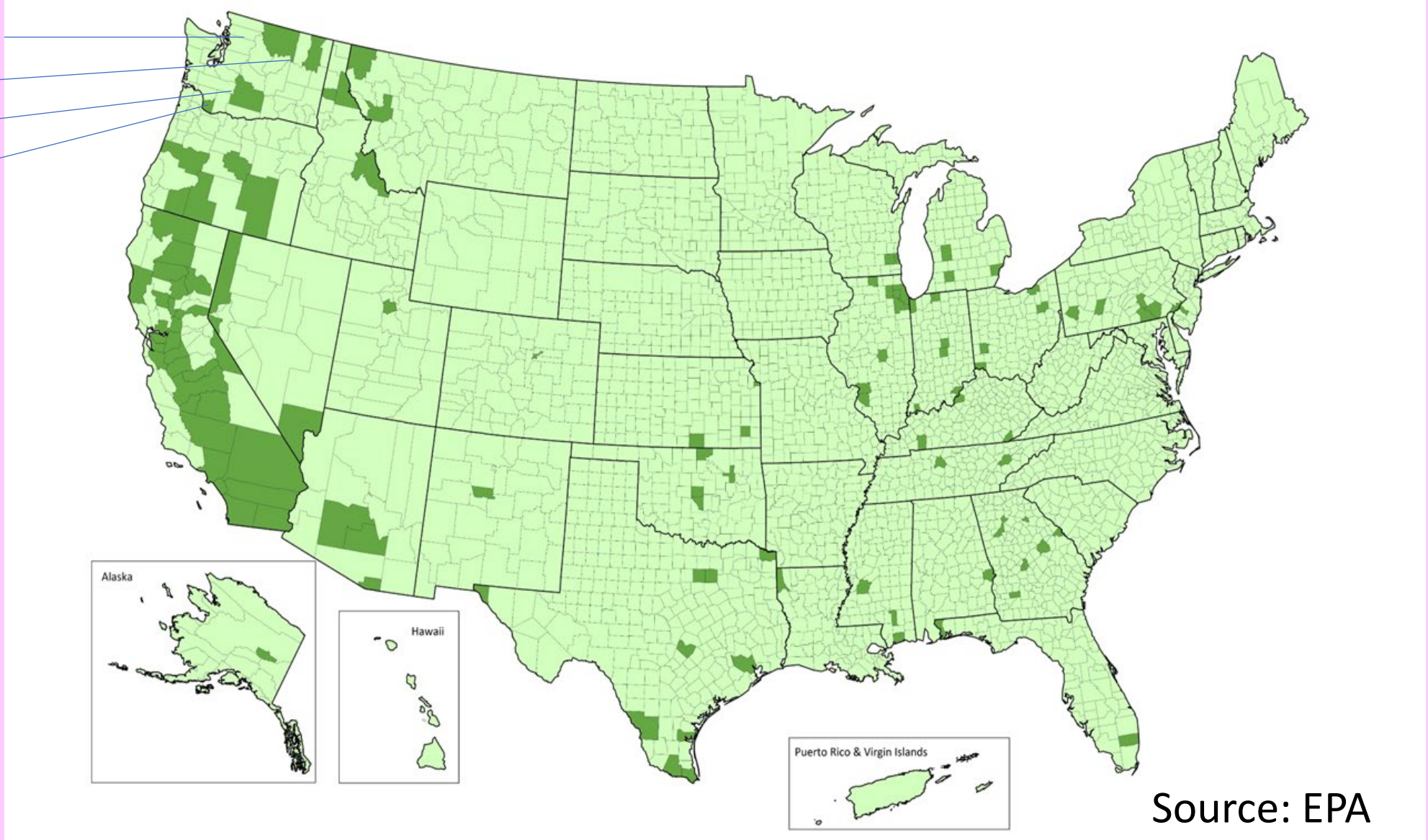


This only considers exceedances of the 35 ug/m³ daily standard.



Non-attainment Areas (NAAs) with new annual PM_{2.5} standard (9 ug/m³)

- Okanogan Cty.
- Stevens Cty.
- Yakima Cty.
- Clark Cty.



Source: EPA

Annual design values

County	2020-2022 DV	2021-2023 DV (est)	Might location meet 9 ug/m3 annual standard by excluding smoke days? (2021-2023)	Total # smoke days needed to exclude (2021-2023)
Okanogan (Omak site)	13.4	12.4	No- Too many high winter days	NA
Stevens (Colville site)	11.6	10.2	Yes	11
Yakima (Toppenish site)	11.8	10.4	Yes	25
Clark (Vancouver site)	9.1	6.6	NA	NA

2024: Are you feeling lucky, kid?

Thoughts on Tiers and “Weight of evidence”

- **Weight of evidence is a good approach! (Can not use statistical significance).**
- **Tiers make sense. Reduce workload for easy cases.**
- **Are the tiers set right?**
- **O₃: Q/D ?**
- **PM_{2.5}:**
 - Highest controllable PM_{2.5} concentrations are in winter. Annual 98th percentiles over-estimate summer-time conditions.**
 - As wildfire cases grow, 98% percentile increases significantly. Catch-22.**

PM_{2.5}, Marshall, MN (AQS 270834210)

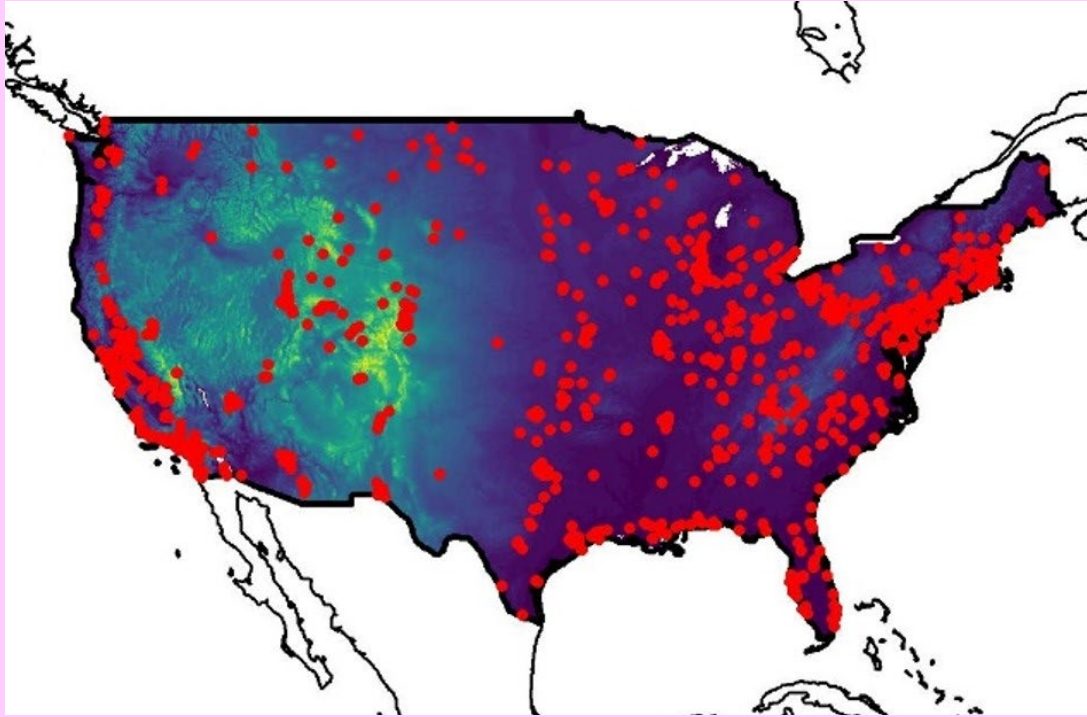
	2019	2020	2021	2022	2023
98th all EPA Tier level, lowest value	16.3	16.6	37.0	13.9	14.4
98th HMS=0	16.5	11.1	11.5	12.5	13.0
98th HMS=0 May-Sept	9.9	11.4	9.8	8.4	9.0
OUR CRITERIA Mean + SD of May-Sept, HMS=0	8.1	8.1	8.1	8.1	8.1

Smoke
inclusion
penalty

Winter
inclusion
penalty

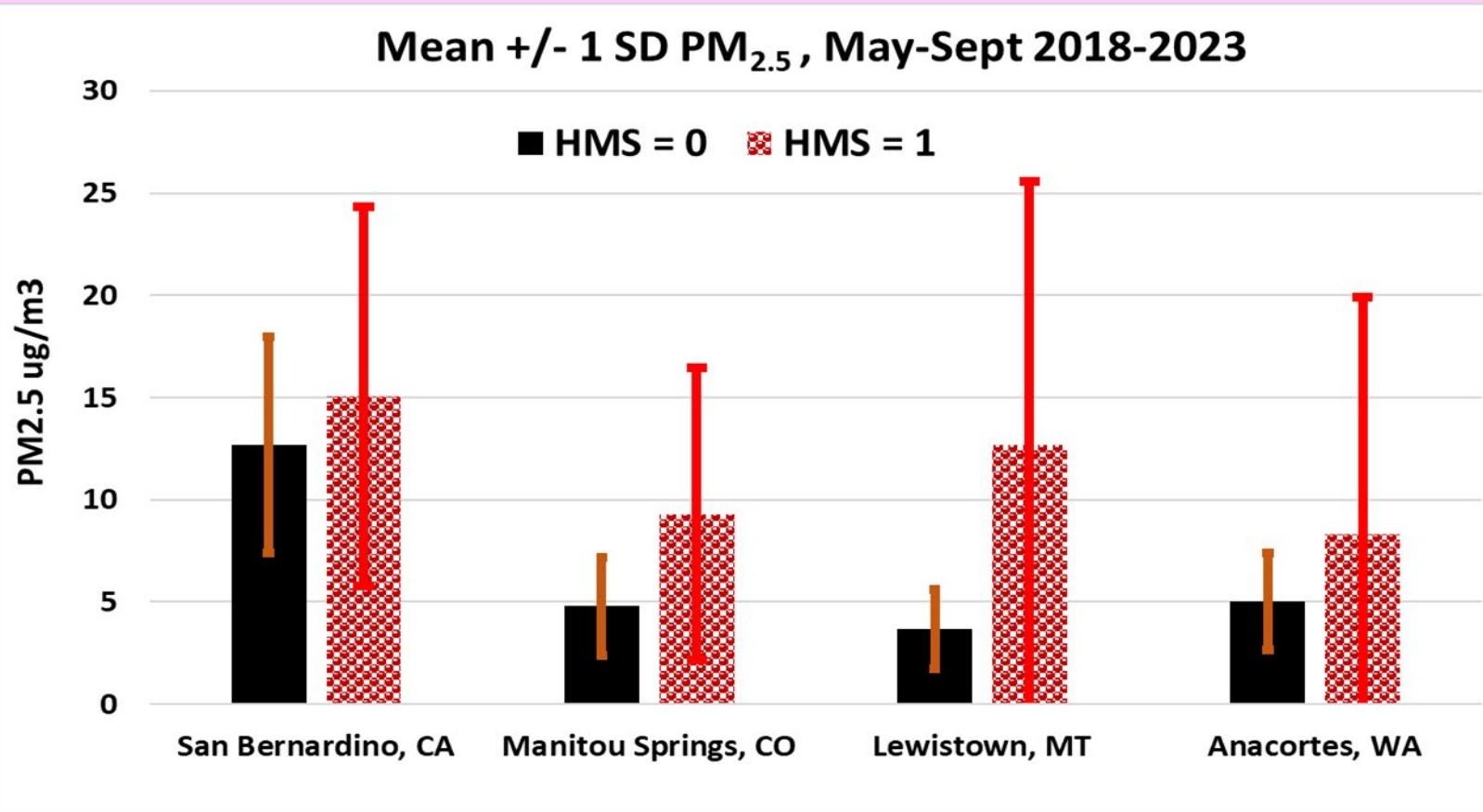
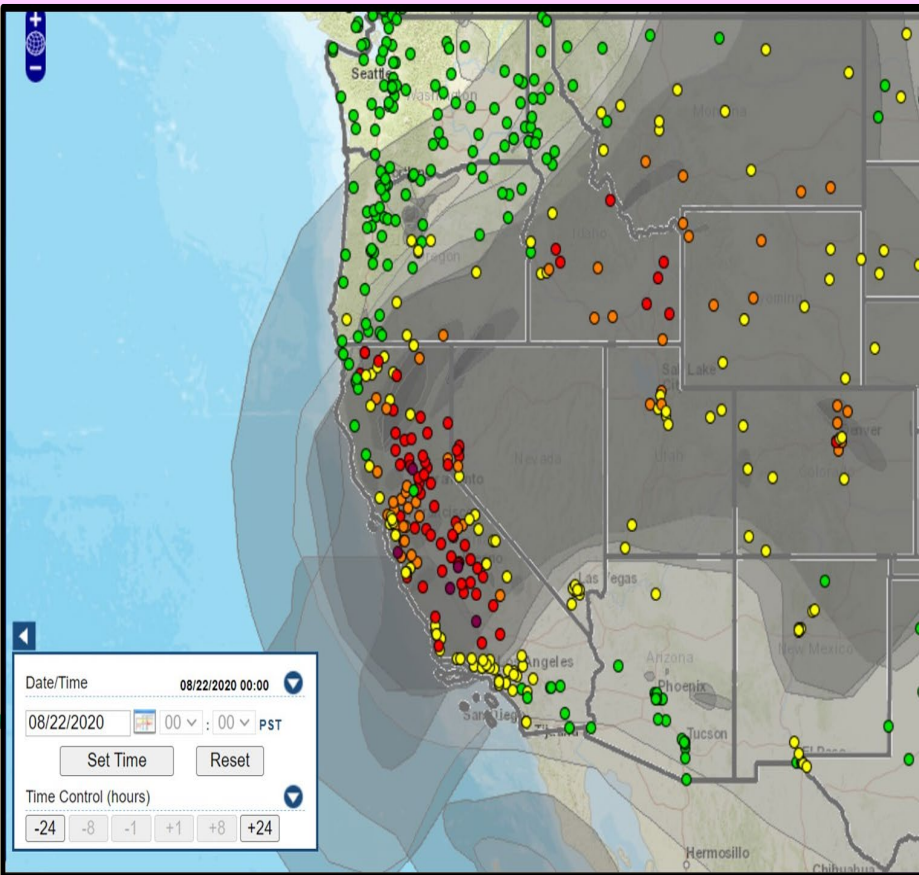
JUNE	98 th percentile ALL	98 th percentile HMS=0
	33.3	13.0

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1. Use surface $\text{PM}_{2.5}$ and HMS smoke product to identify smoke days at each site for every day.
2. Use GAM to quantify expected O_3 based on meteorology.
3. Estimate smoke contribution to daily $\text{PM}_{2.5}$ and MDA8 O_3 for every site, for every day, with appropriate statistical limitations.

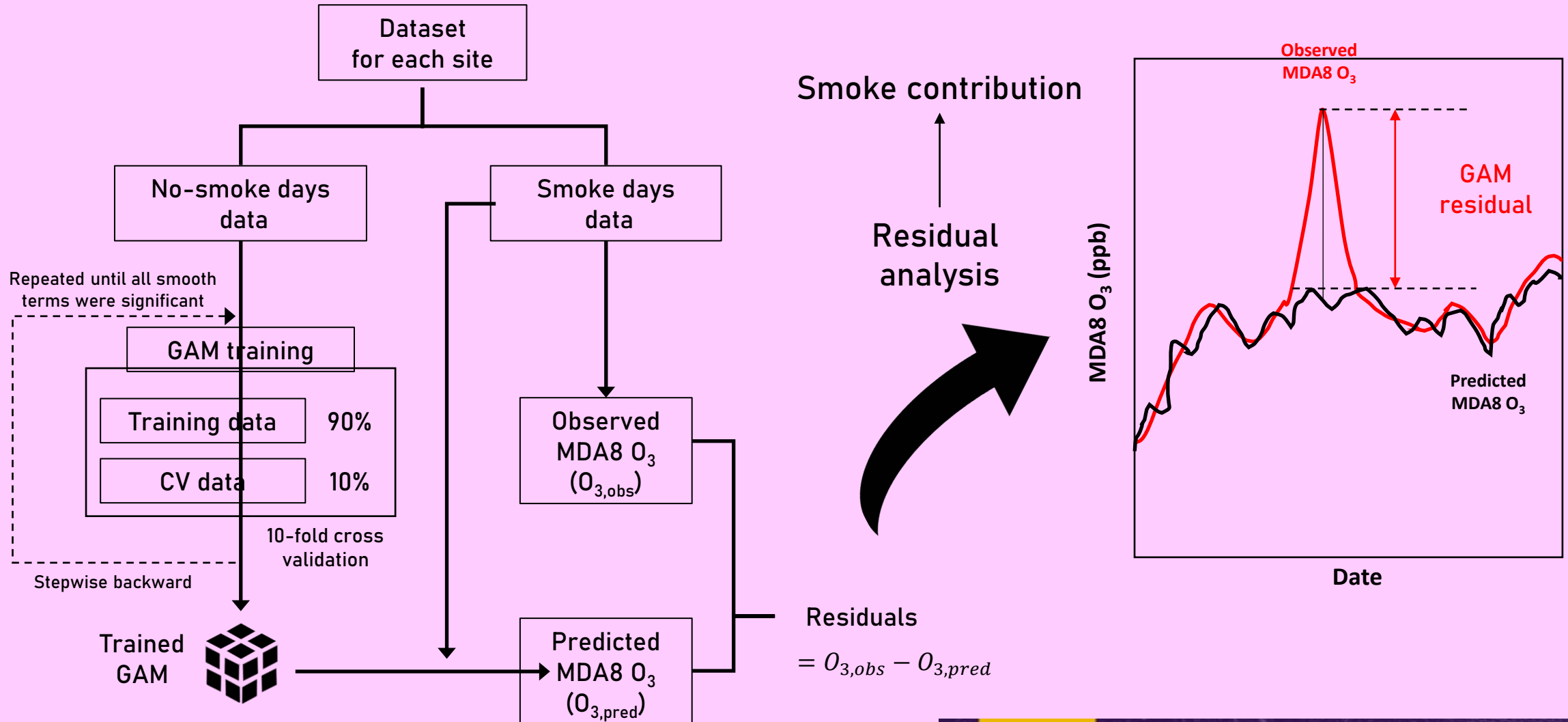
Use surface PM_{2.5} and HMS smoke to identify smoke days



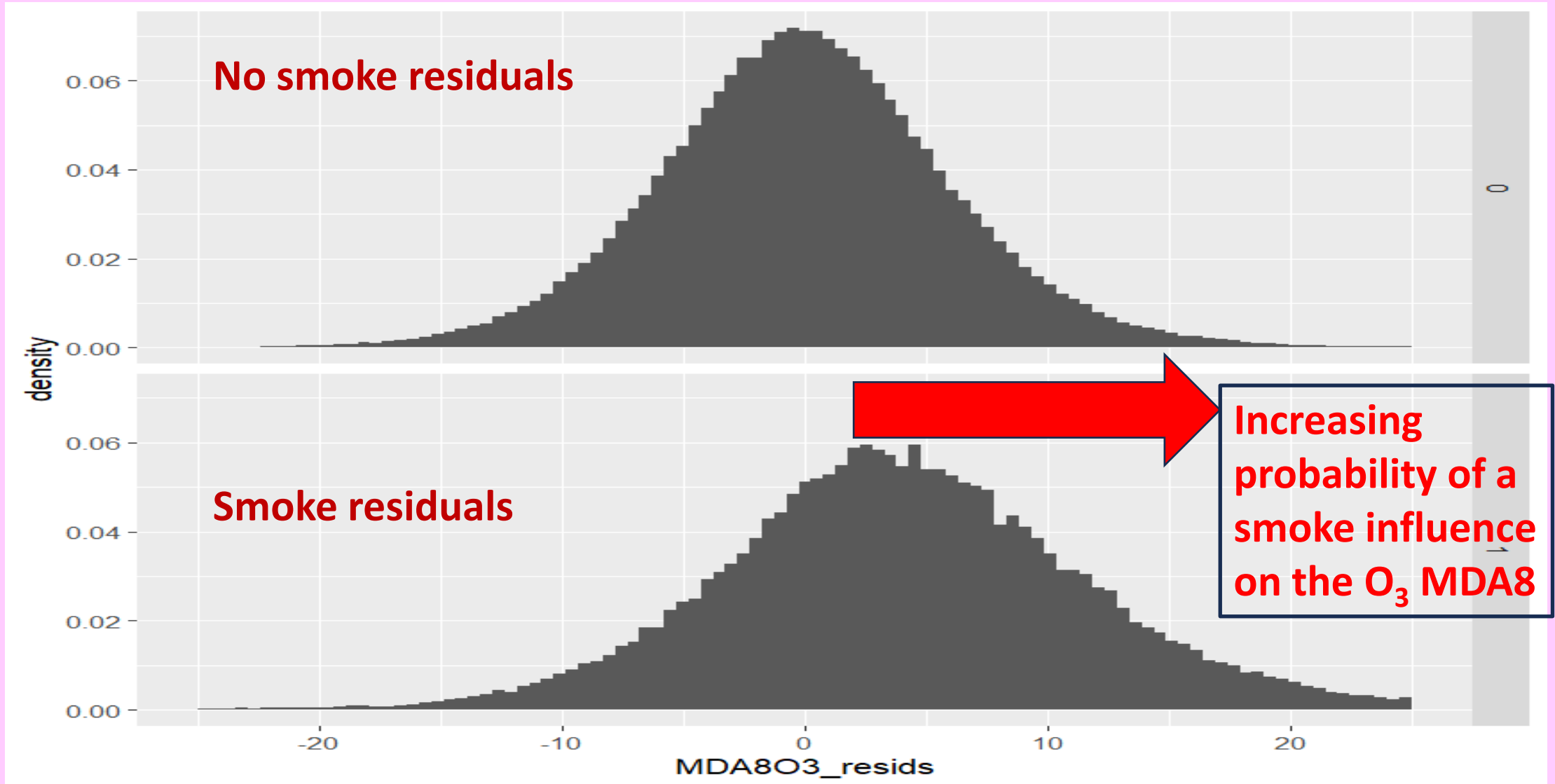
“Smoke day” = Day with detected HMS smoke and PM_{2.5} > Mean + 1 SD of HMS=0 days

Smoke PM_{2.5} Criteria = Mean + 1 SD of HMS=0 days

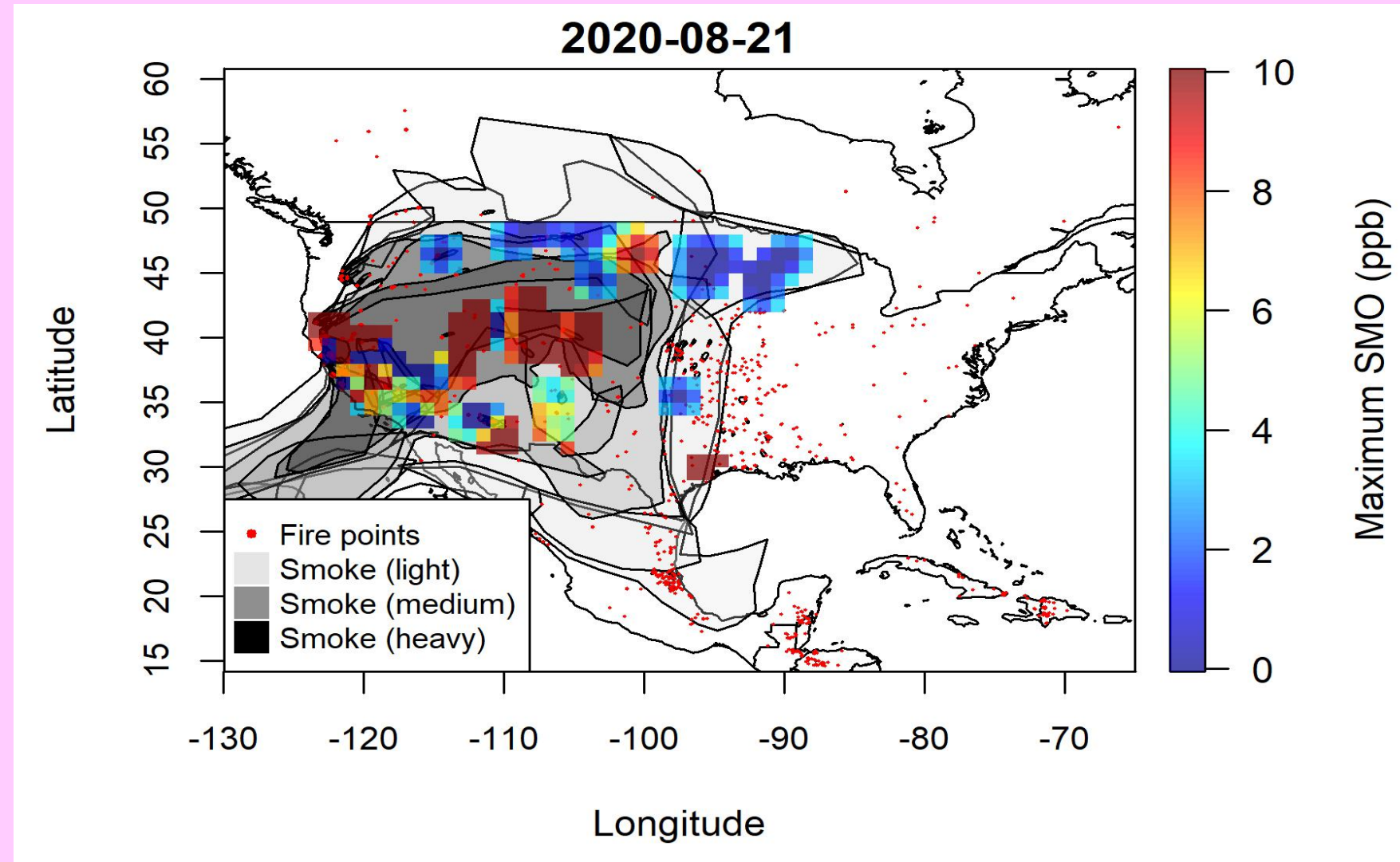
Statistical model to answer the question: What would we be expected MDA8 O₃ given the meteorology?



Statistical evaluation



Database of smoke days, smoke contribution to $\text{PM}_{2.5}$ and MDA8 O_3 for every AQS site for every day



Smoke contribution to the MDA8 O_3 for Aug. 21, 2020

Database of smoke days, smoke contribution to PM_{2.5} and MDA8 O₃ for every AQS site for every day

AQS	Date	MDA8	PM2.5	Smoke day	Smoke O ₃	Smoke PM _{2.5}
530110024	8/1/2025	65	8	N	NA	NA
530110024	8/2/2025	63	5	N	NA	NA
530110024	8/3/2025	71	12	Y	3	4

Remaining issues

1. States still needs to identify fire source and whether it was controllable.
2. States still have statutory requirements as set forth by EPA.
3. For O_3 , this only works for sites that have also have $PM_{2.5}$.
4. Currently, it is likely that we are underestimating smoke influence. Still need to tweak.
5. Nothing is perfect. There may be borderline cases that don't fit well into these definitions. Still need to work on statistical framework.

Benefits

1. Improved tiers can help reduce workload for all.
2. Clear definition as to what counts as a smoke influenced day;
3. Less uncertainty over how much PM and O_3 smoke contributed on a specific day;
4. Reduced workload for the states;

Recommendations: How to get there?

1. EPA should consider improving Tier levels to better reflect scientific understanding of $PM_{2.5}$ and O_3 ;
2. PM tiers 98th (percentiles) could easily incorporate a metric like the HMS data to better represent controllable and uncontrollable sources.
3. O_3 tiers could reflect how far away an MDA8 value is from “expected O_3 ” for a given meteorological conditions. This is what the GAMs do, although this is not the only way to accomplish.
4. Every year someone (EPA, states, contractor?) compile needed data and runs analysis for smoke days and smoke contribution to $PM_{2.5}$ and MDA8 O_3 for every AQS site with appropriate data.
5. Ideally this would be done with a consistent set of statistical metrics and run for the entire country.
6. States could then use this analysis as part of streamlined EE documentation.

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