

Combining low-cost sensors and satellite data to quantify smoke exposure in rural regions

Jeff Pierce, Olivia Sablan, Bonne Ford, Emily Fischer, Sheryl Magzamen, Amber Soja, Emily Gargulinski, many others

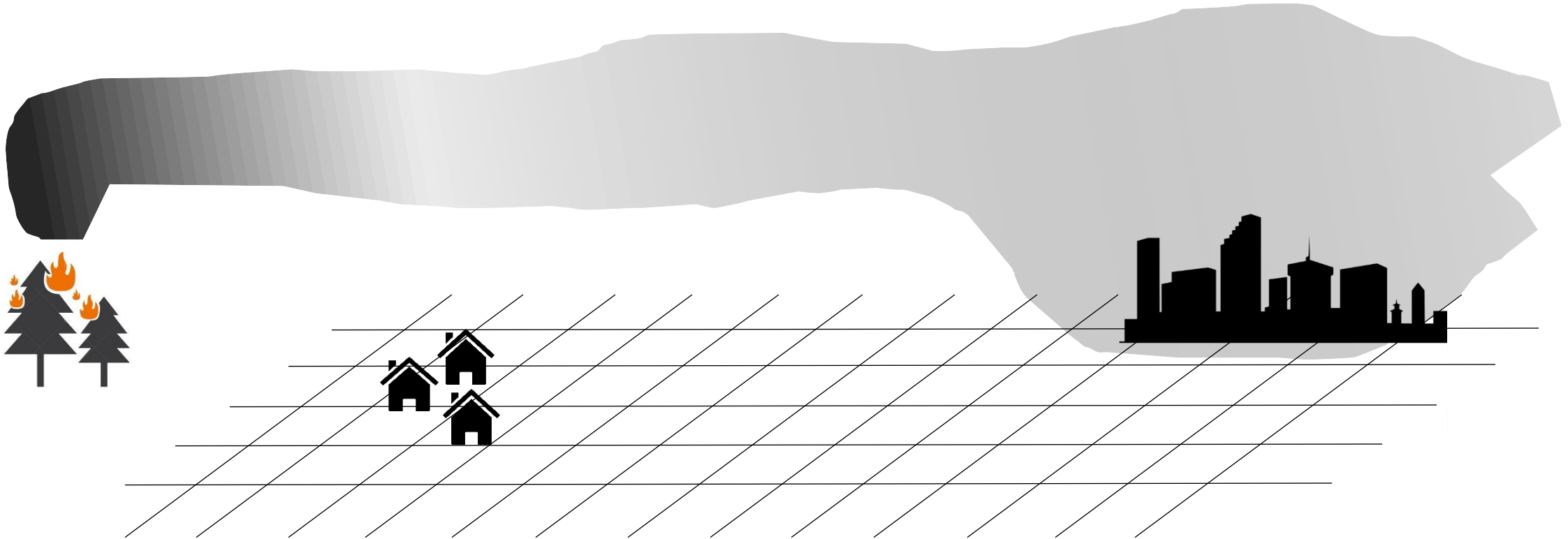
CSU, Atmospheric Science



We have developed smoke exposure datasets that combine satellite and surface-monitor information.



Satellites – Can detect the plumes spatial extent, but usually can't tell us about surface impacts.

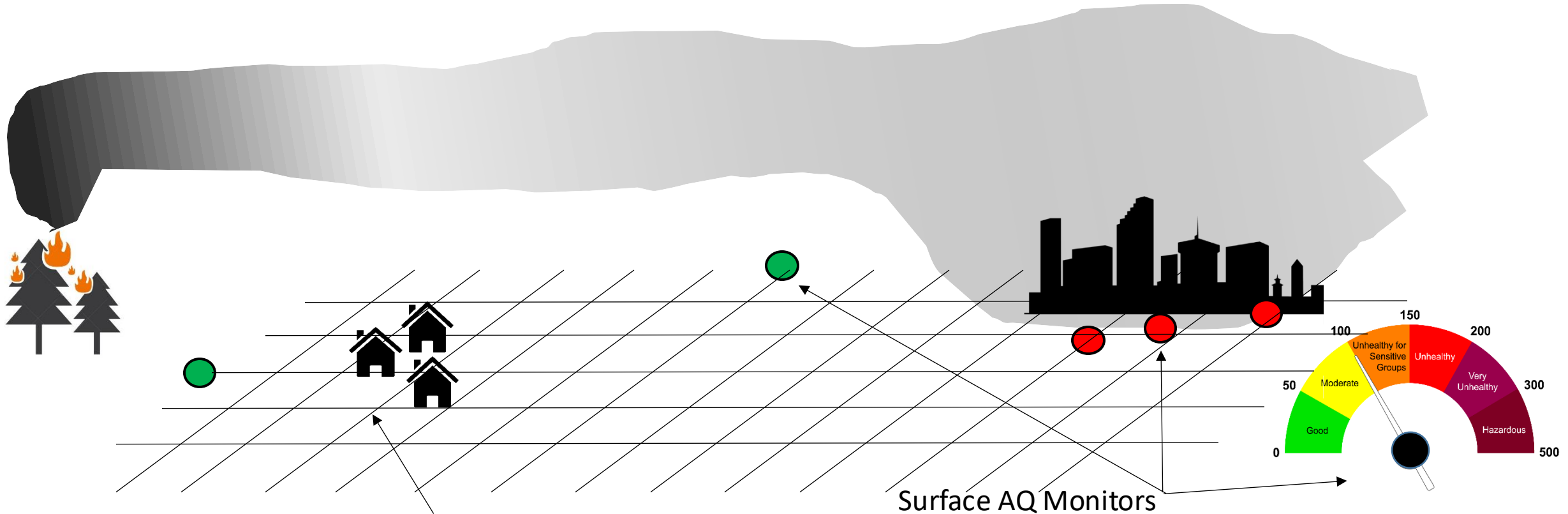


Slide courtesy of Emily Fischer

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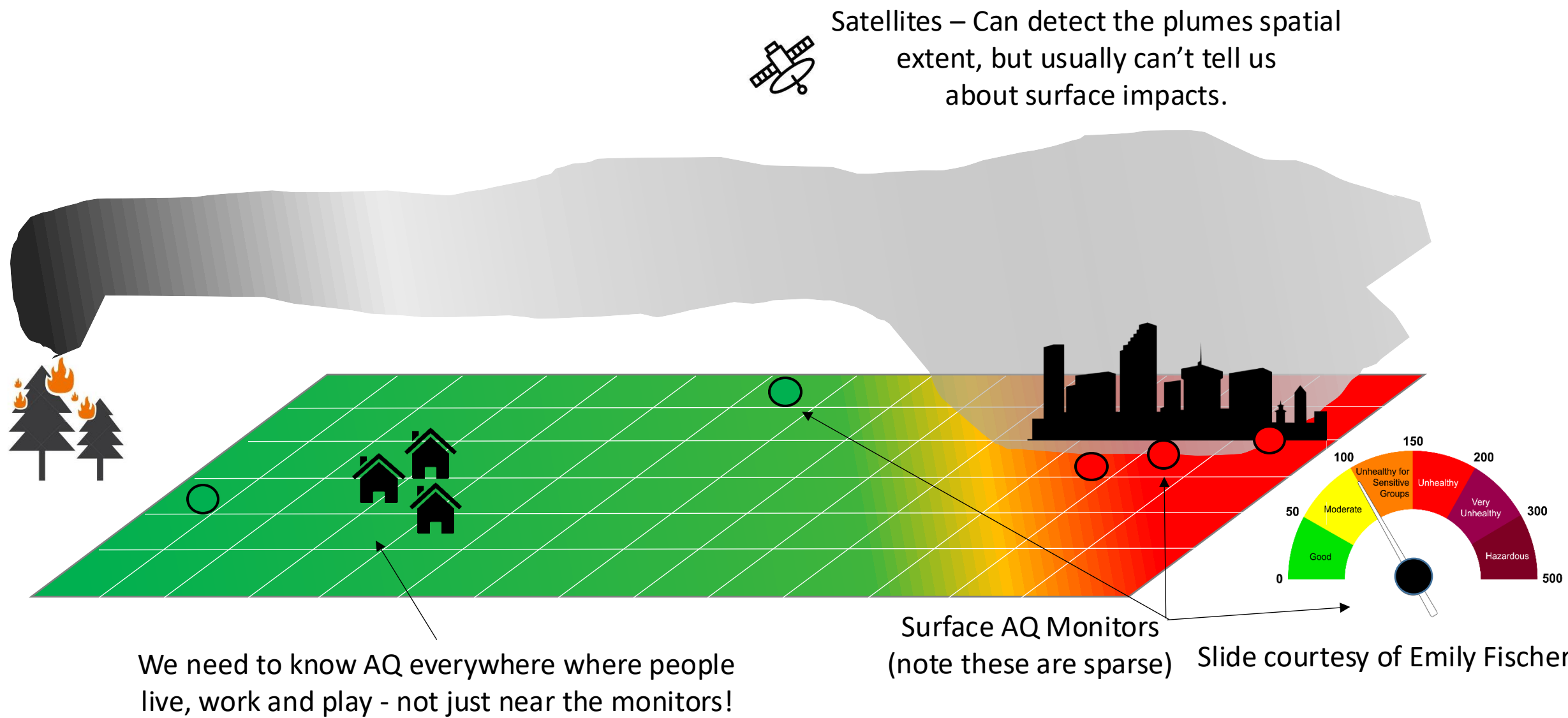
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We need to know AQ everywhere where people live, work and play - not just near the monitors!

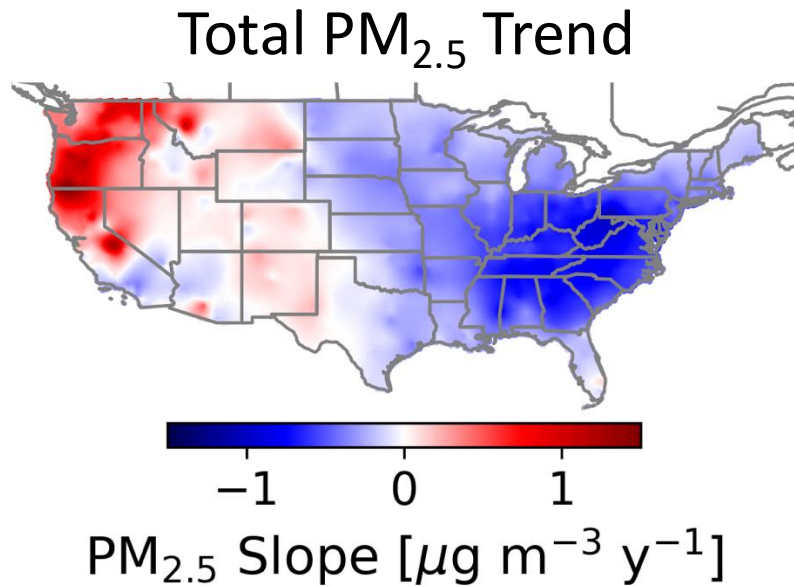
Surface AQ Monitors
(note these are sparse) Slide courtesy of Emily Fischer

Blend information from satellites and surface monitors to create gridded smoke product.



Application: Summertime particulate matter is getting worse in the western US.

2006 – 2020 trends in summer $\text{PM}_{2.5}$

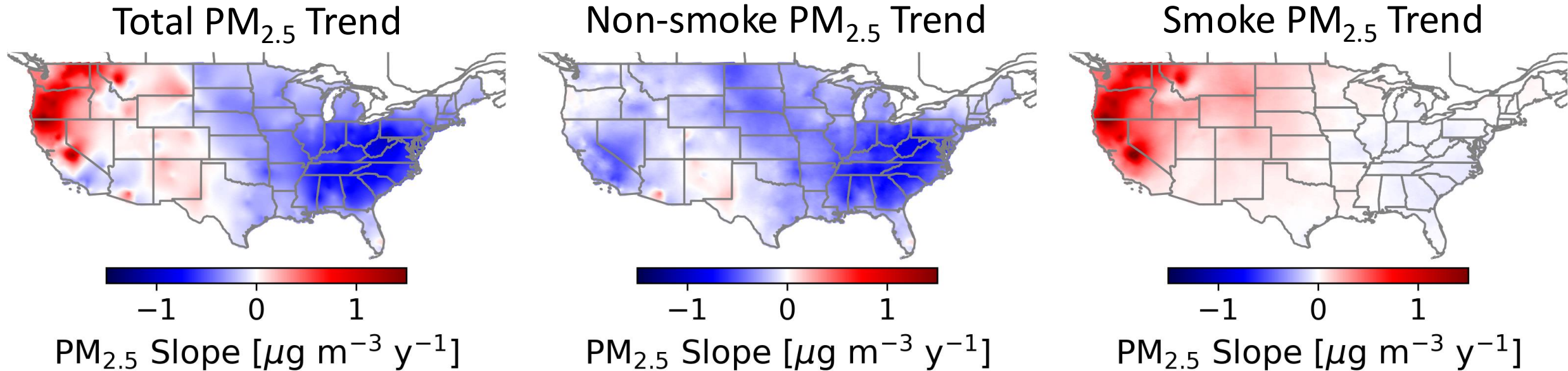


Katelyn O'Dell, Bonne Ford, Emily V. Fischer, and Jeffrey R. Pierce. (2019). Contribution of wildland-fire smoke to US $\text{PM}_{2.5}$ and its influence on recent trends. ES&T. doi: 10.1021/acs.est.8b05430.



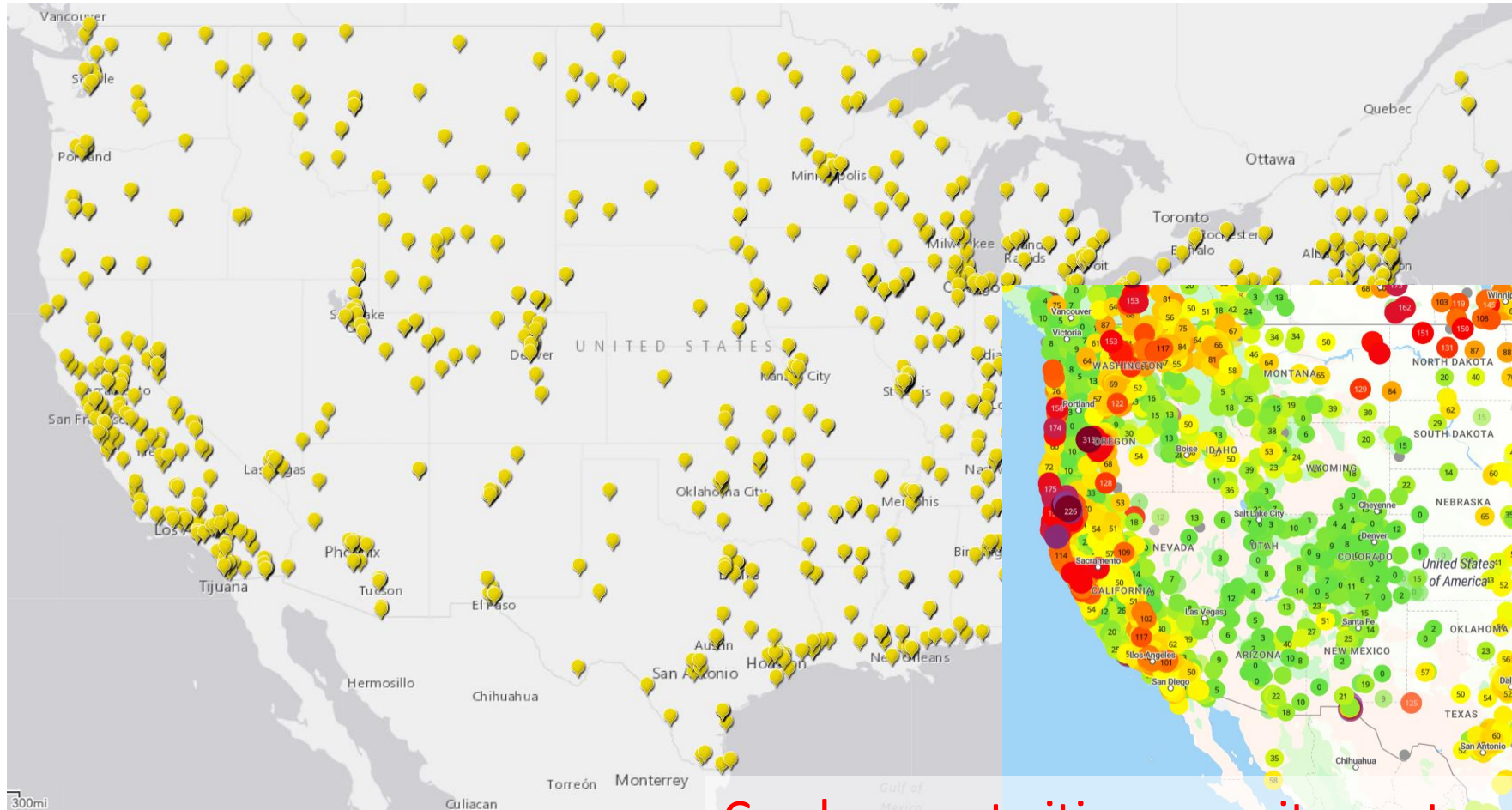
Application: Summertime particulate matter is getting worse in the western US. It's the smoke!

2006 – 2020 trends in summer $\text{PM}_{2.5}$

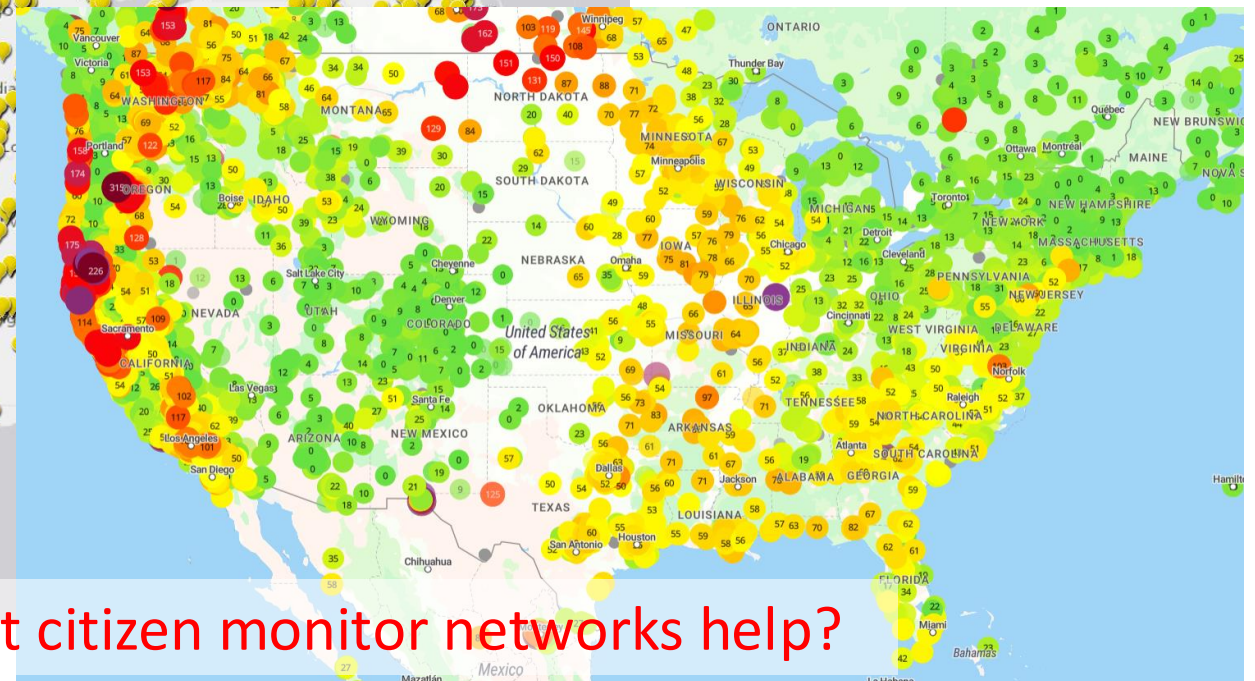


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But our method can fail for smoke plumes away from regulatory monitors.

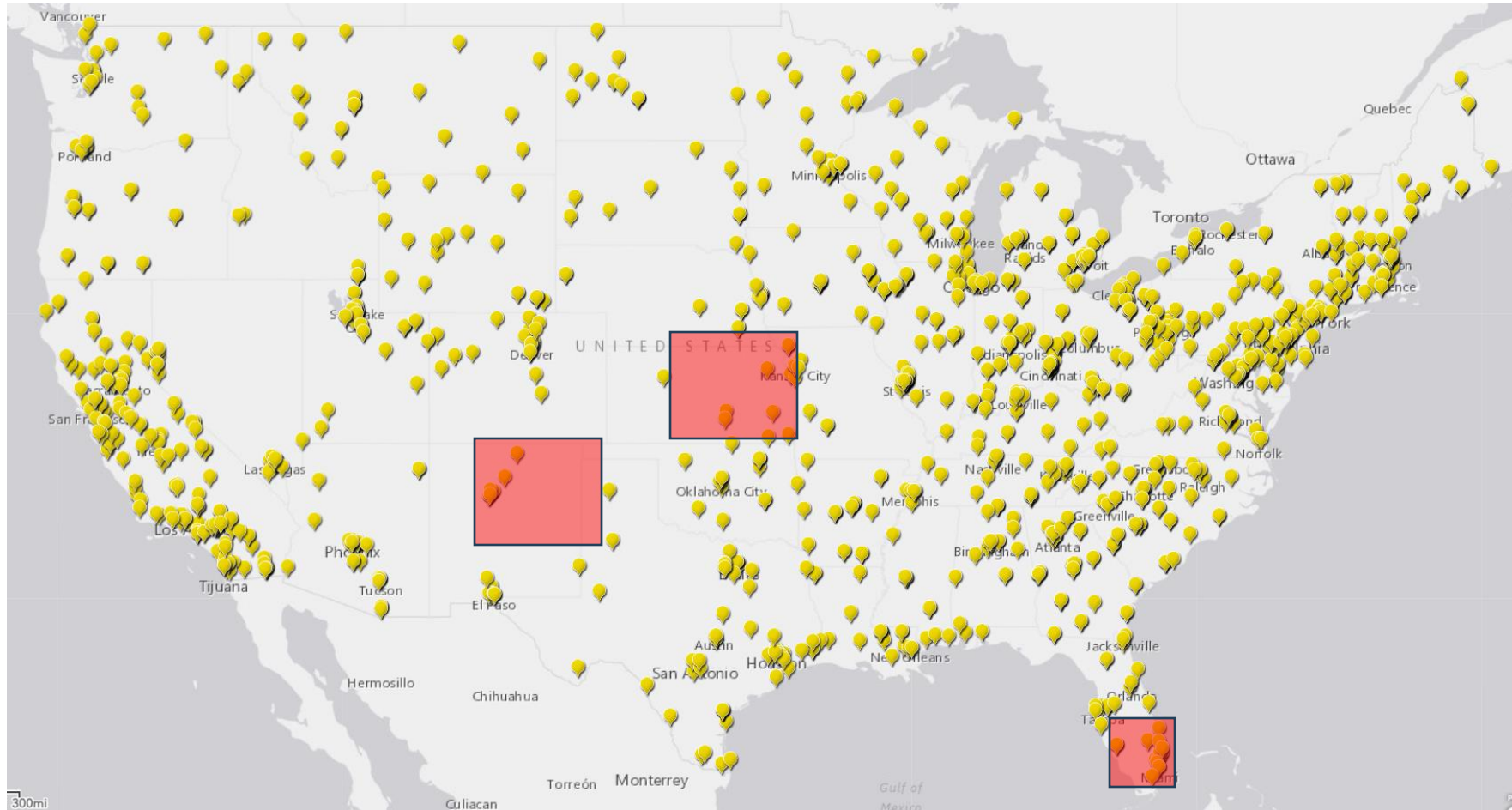


Active regulatory PM_{2.5} monitors.



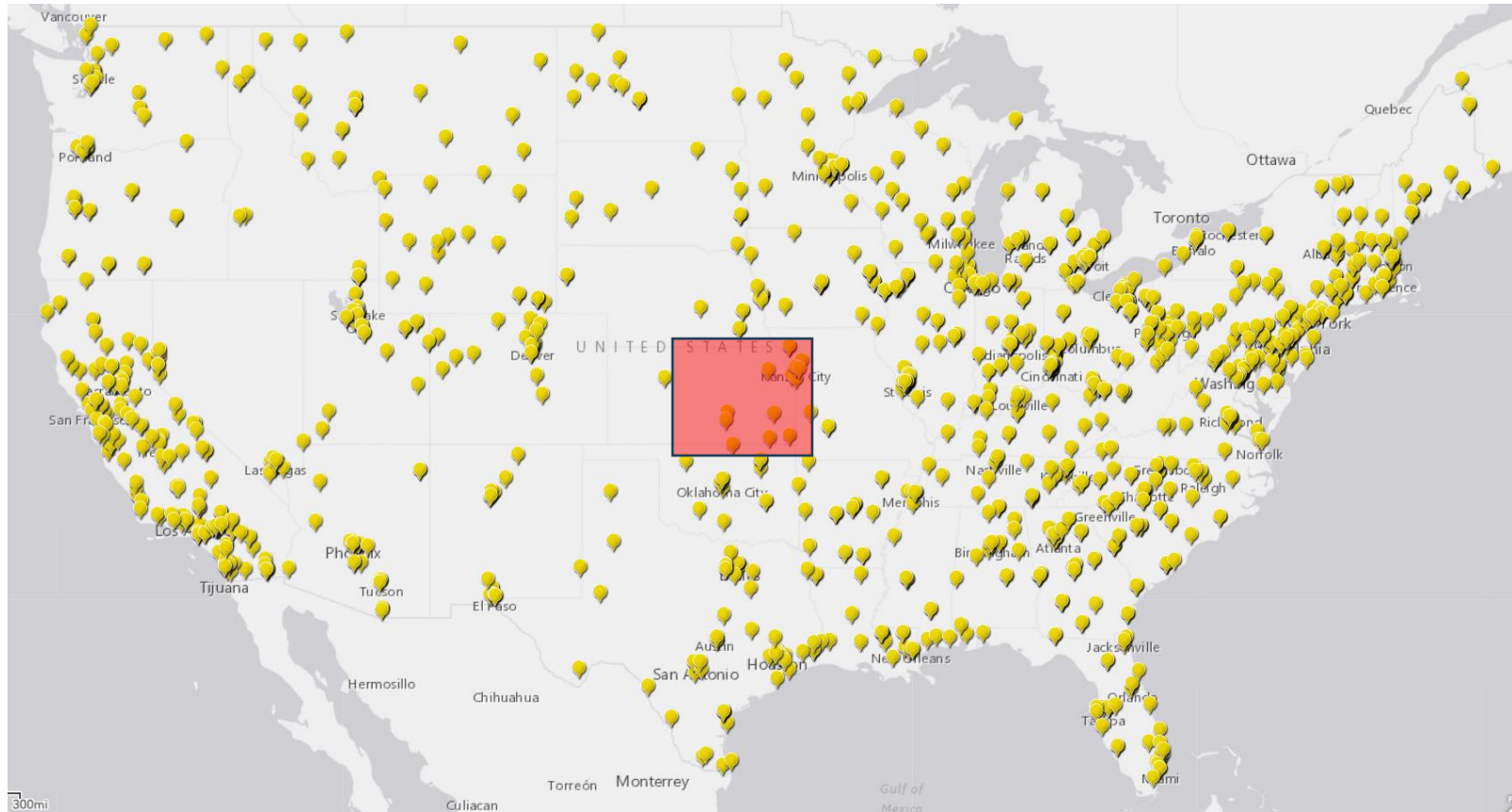
Can low-cost citizen monitor networks help?

3 HAQAST smoke study regions with gaps in regulatory monitors



Active regulatory PM_{2.5}
monitors.

Kansas: Spring prescribed fires in the Flint Hills

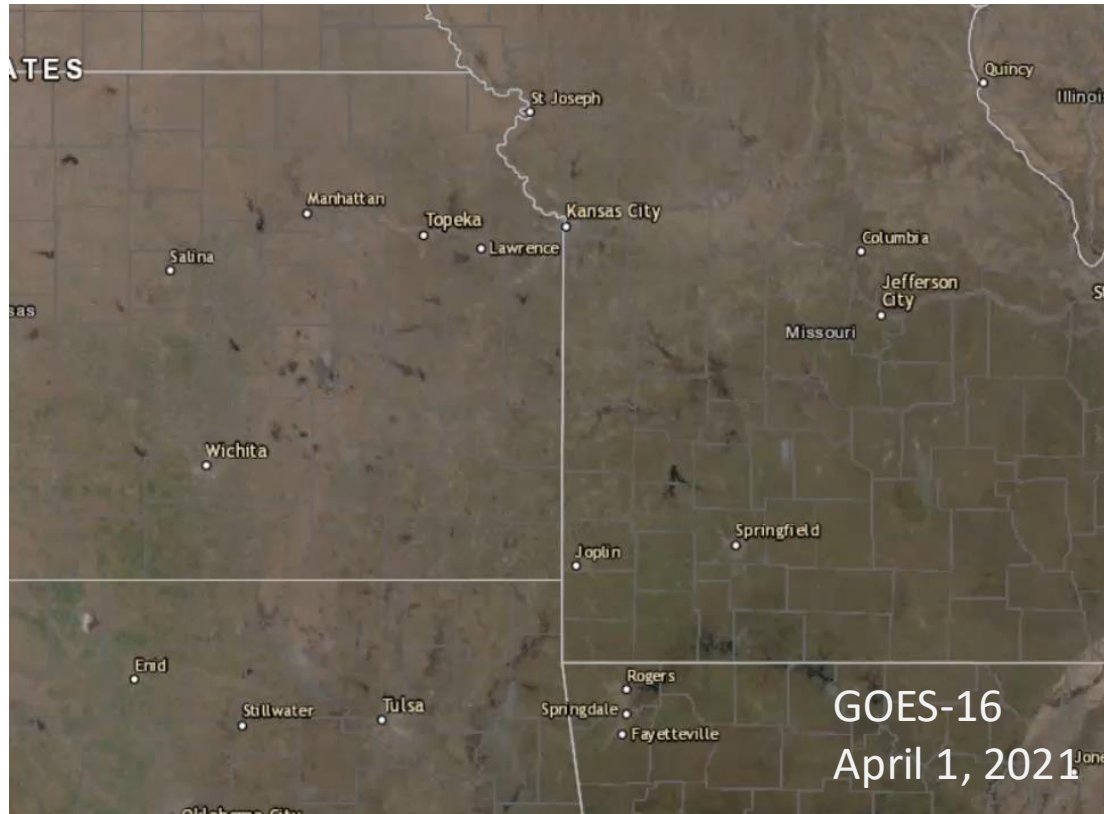


Annual springtime burning to:

- Decrease risk of wildfires
- Maintain the tallgrass ecosystem
 - Control invasive species
 - Decreasing woody encroachment
- Improve nutrition for livestock

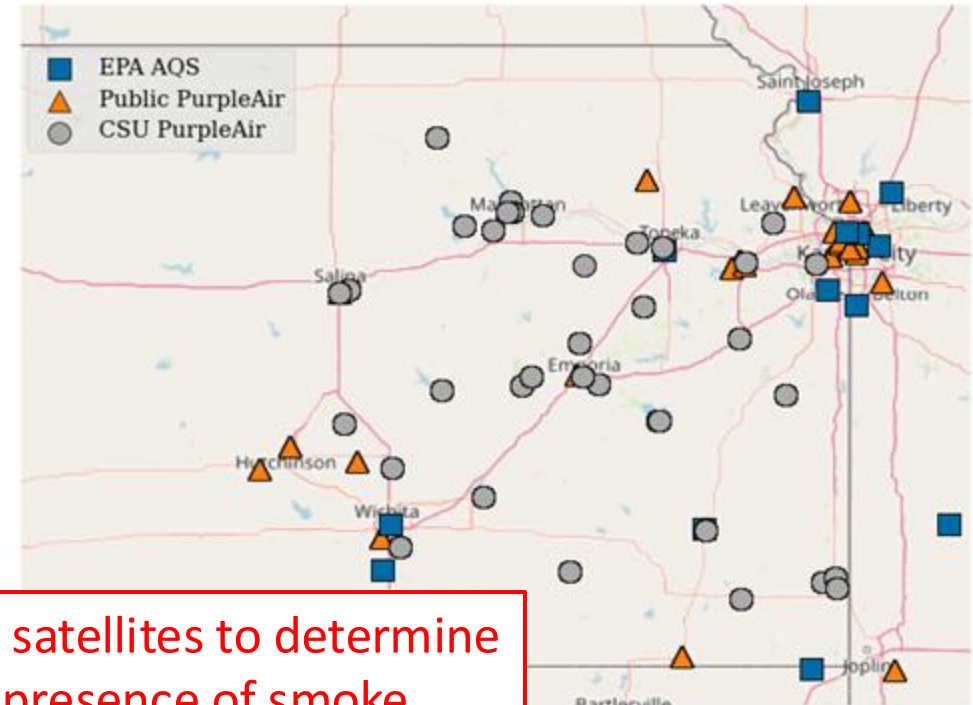
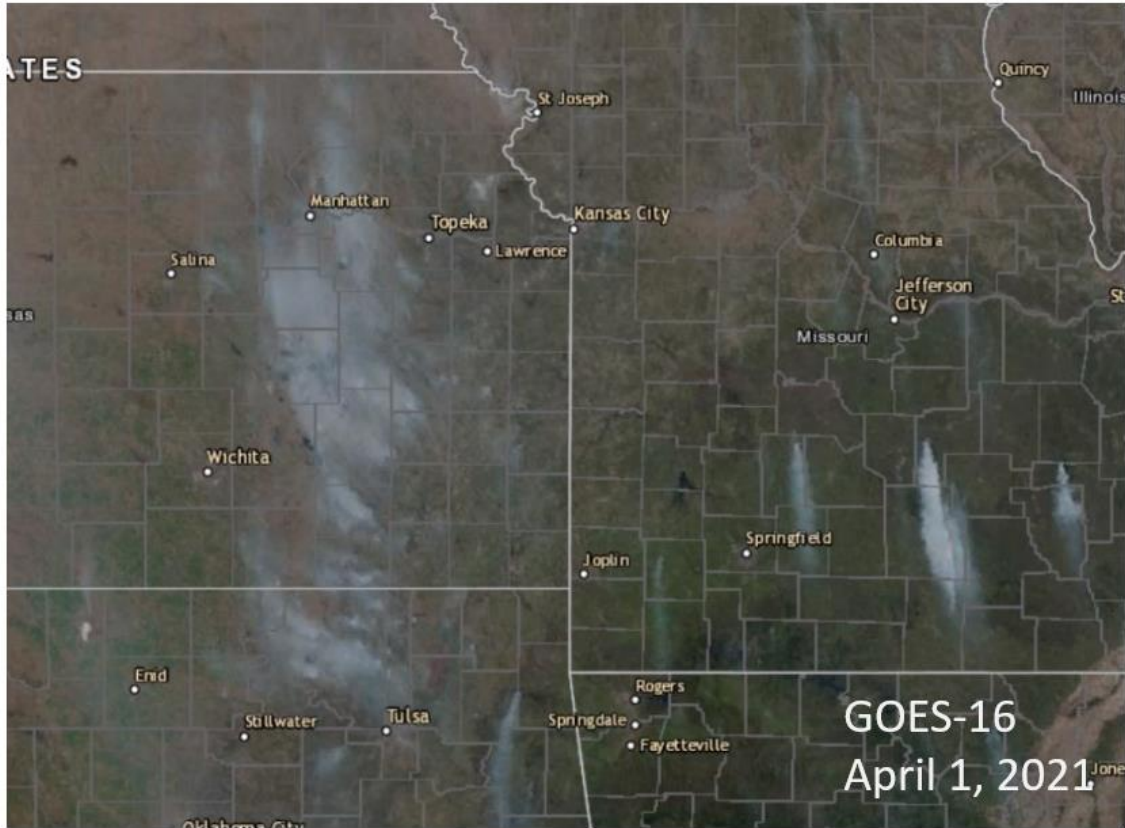
Partners: Kansas Department of Health and Environment, community partners

Prescribed fires in the Flint Hills away from regulatory monitors.



Partners: Kansas Department of Health and Environment,
community members

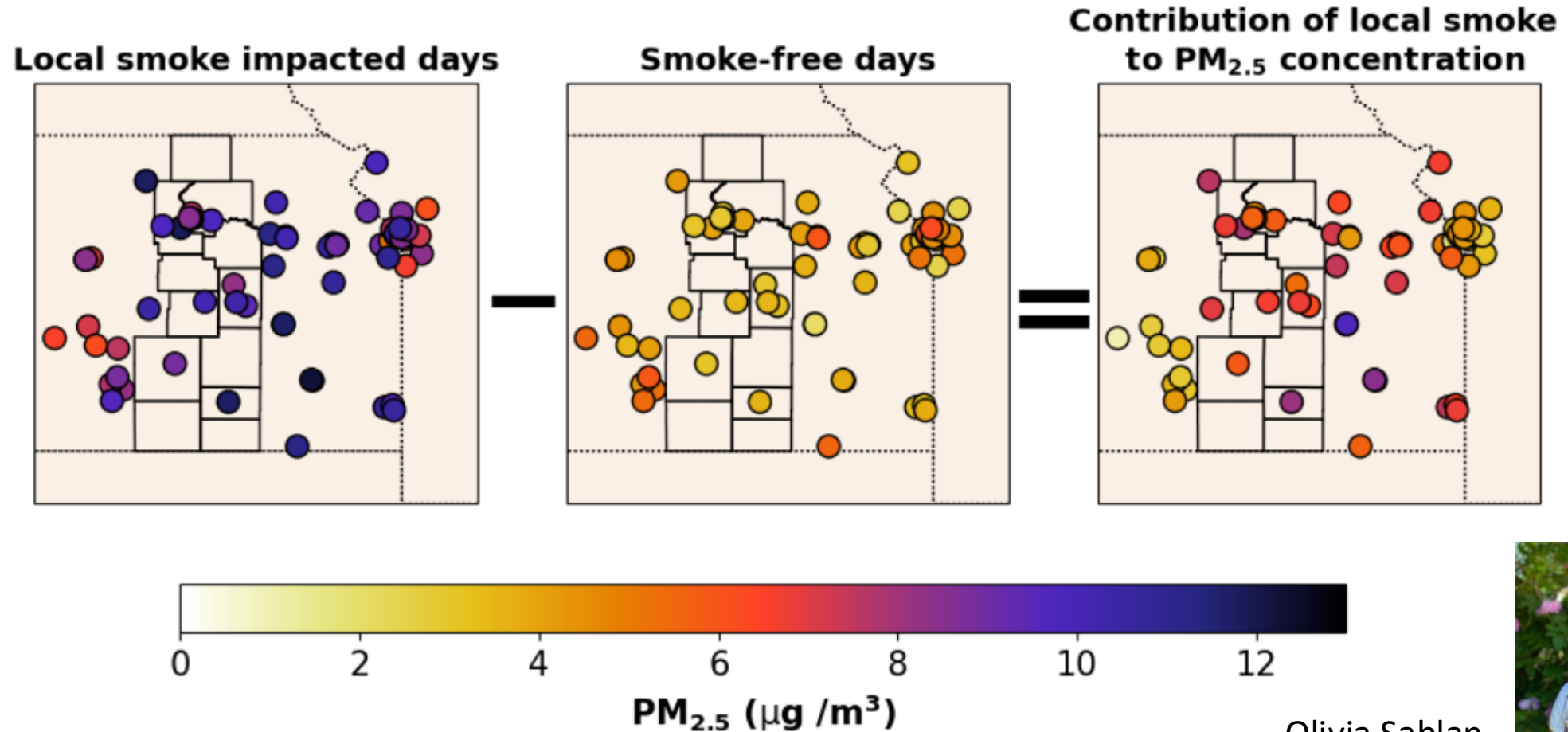
Incorporate low-cost monitors to fill the gaps.



Use satellites to determine the presence of smoke from local fires

Partners: Kansas Department of Health and Environment, community members

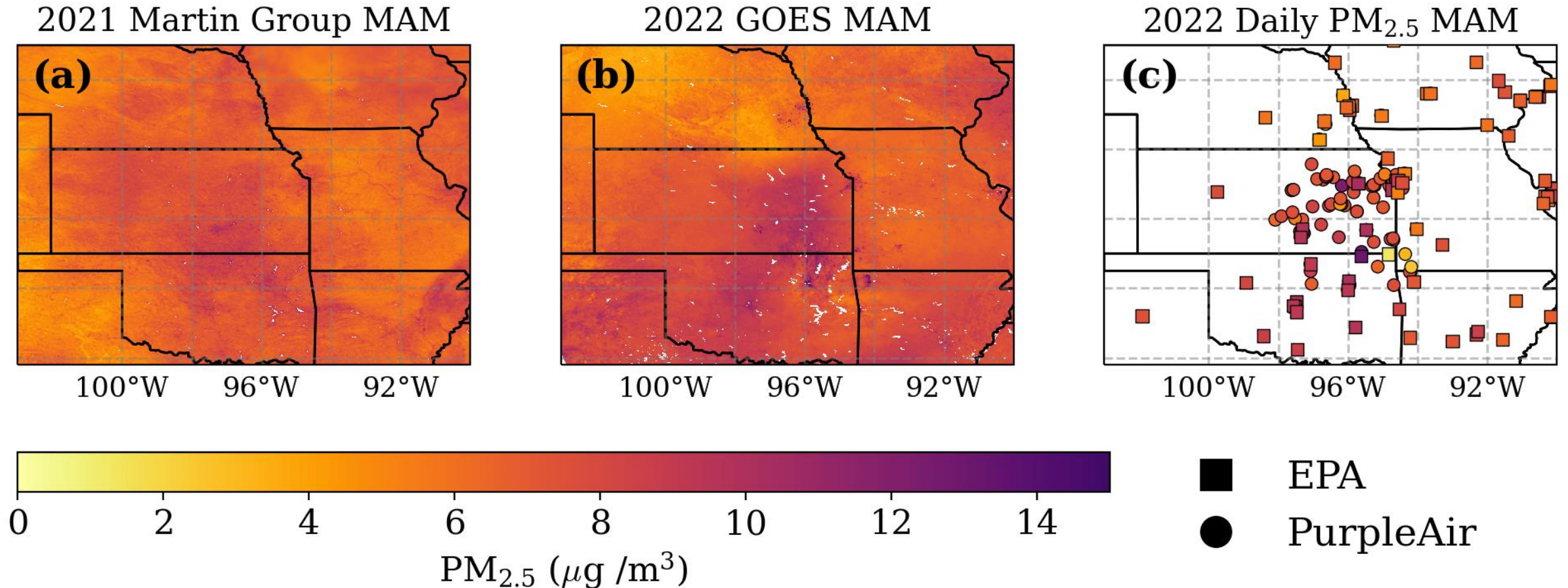
On days with local burning, the $\text{PM}_{2.5}$ concentrations more the double



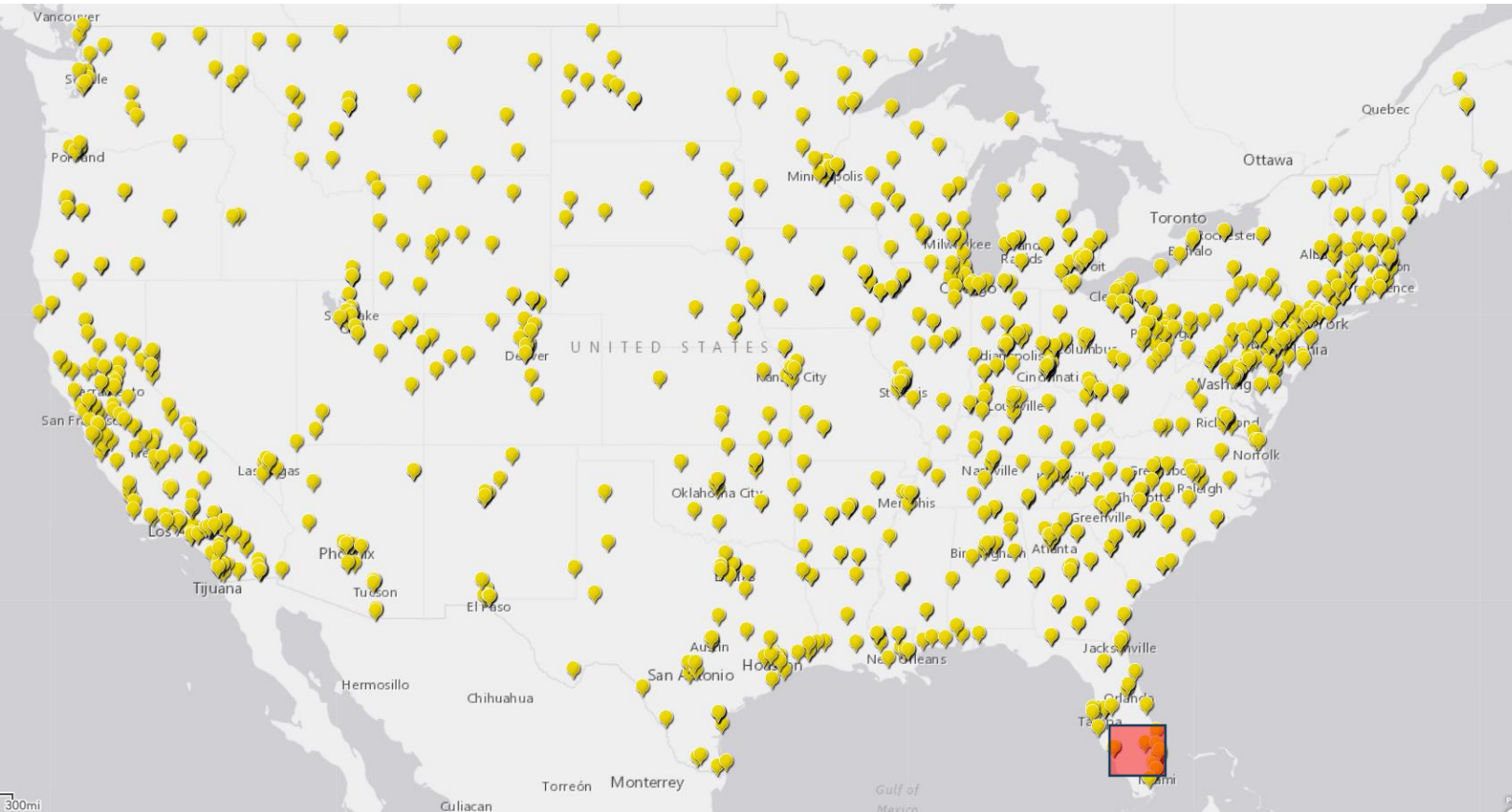
Olivia Sablan



Satellite-derived PM_{2.5} products capture the springtime PM maximum in eastern KS



Southern Florida: Agricultural burning



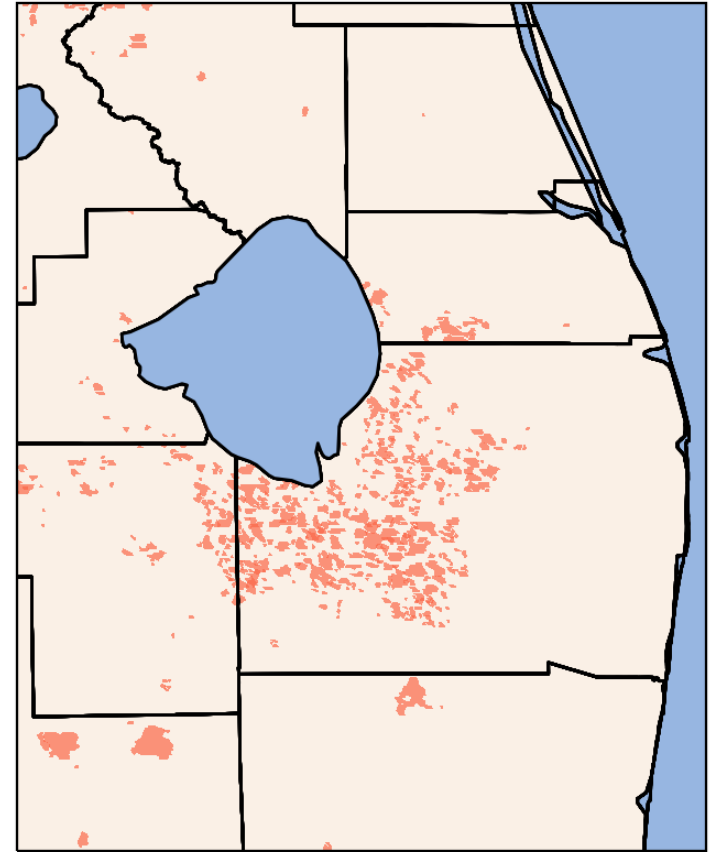
Annual colder months burning of sugarcane fields as a quick method to ease harvesting at a low cost.

Partners: Florida Atlantic University, community partners

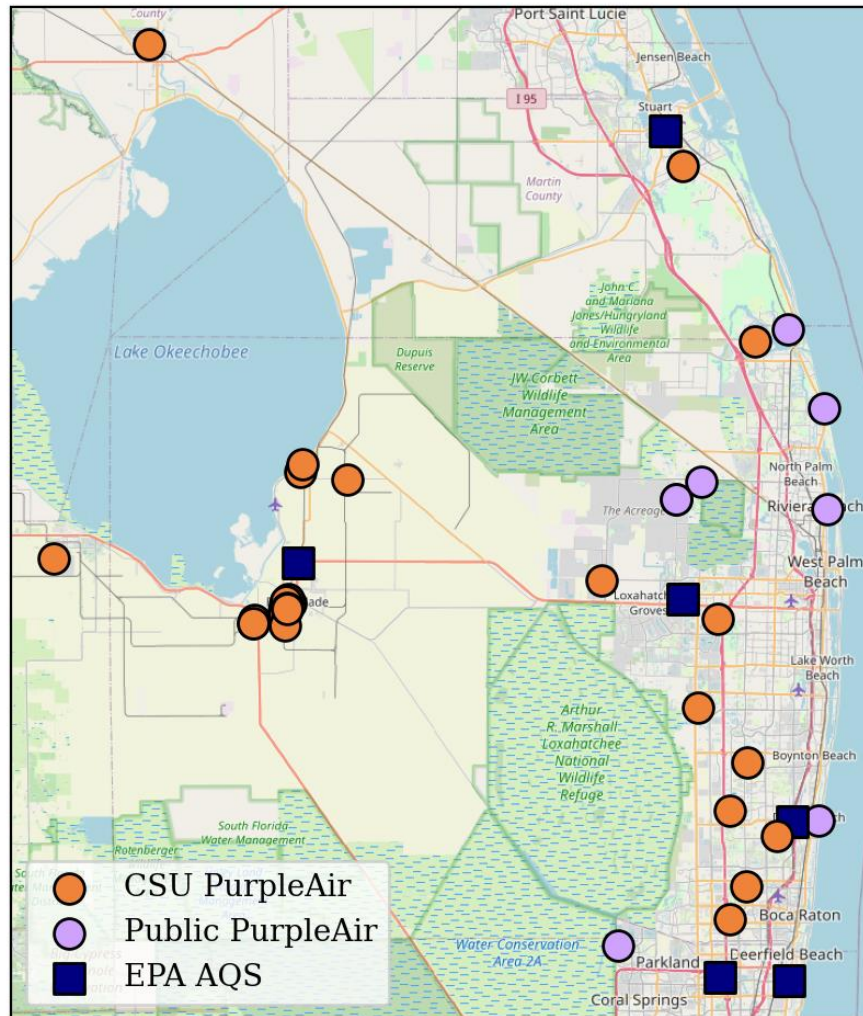
Agricultural burning covers much of the area of south-central Florida



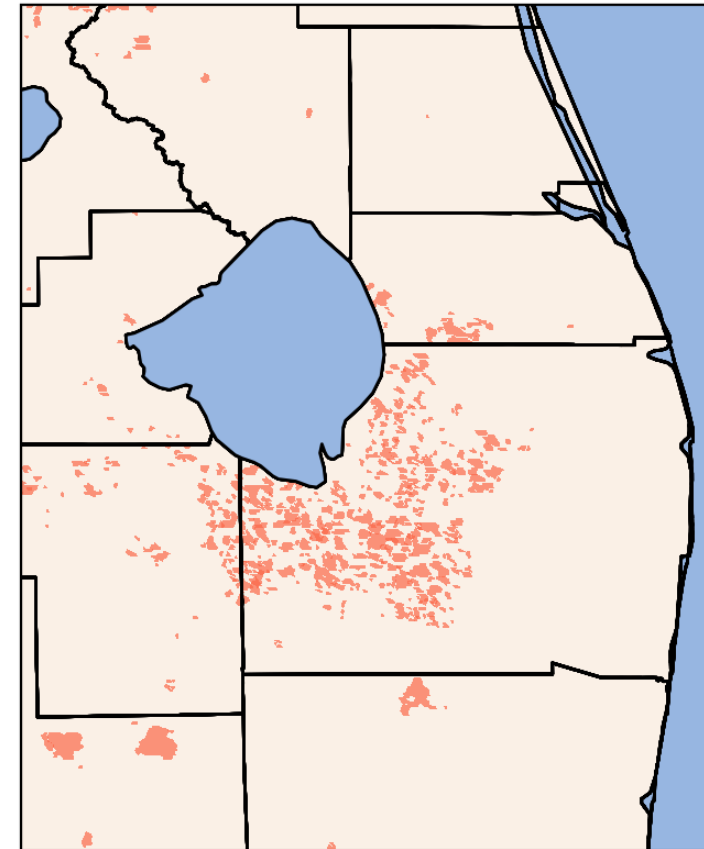
2022-2023 Burned Area
from MODIS (Oct - May)



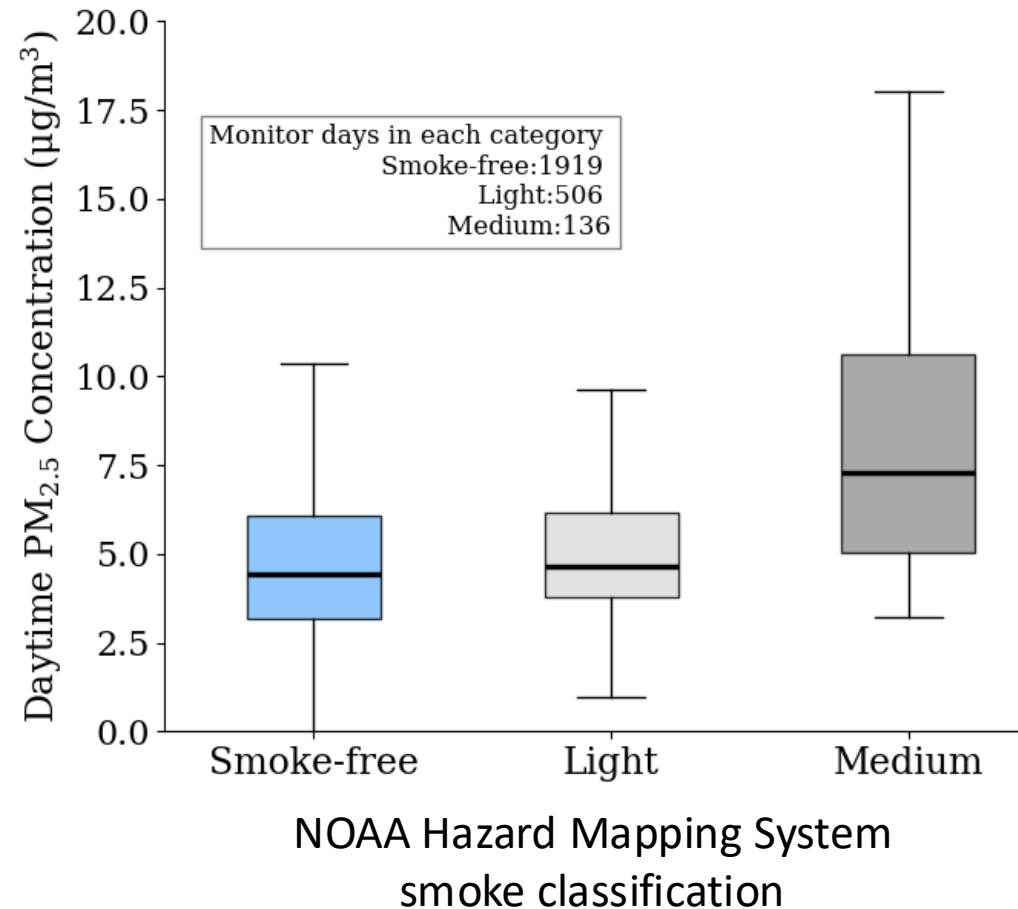
Again, there is a lack of regulatory monitors in the main burning region.



2022-2023 Burned Area
from MODIS (Oct - May)



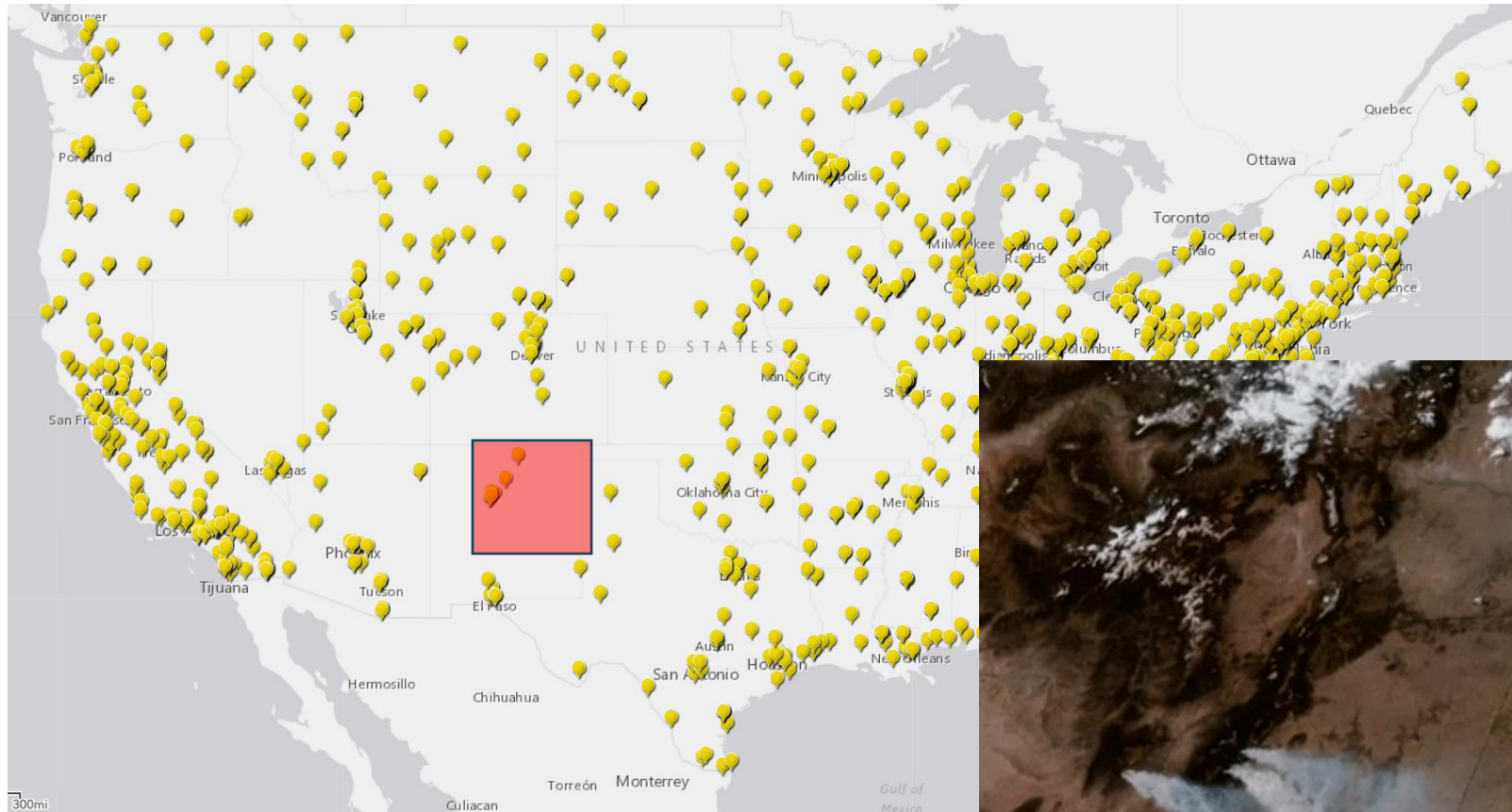
Days deemed as having “medium” smoke from local fires had ~50% higher PM_{2.5} concentrations.



Olivia Sablan

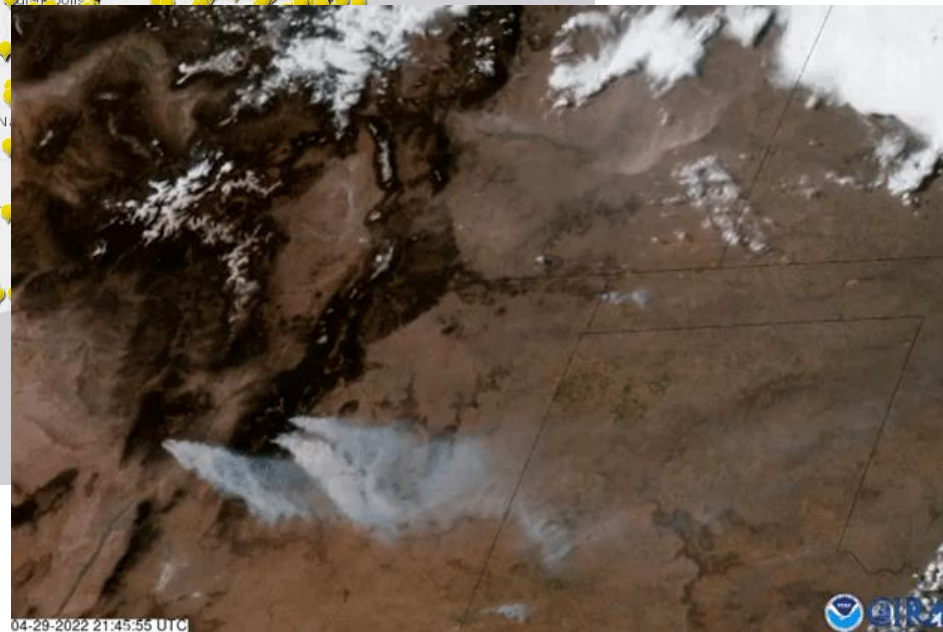


New Mexico: Bad wildfire season in 2022

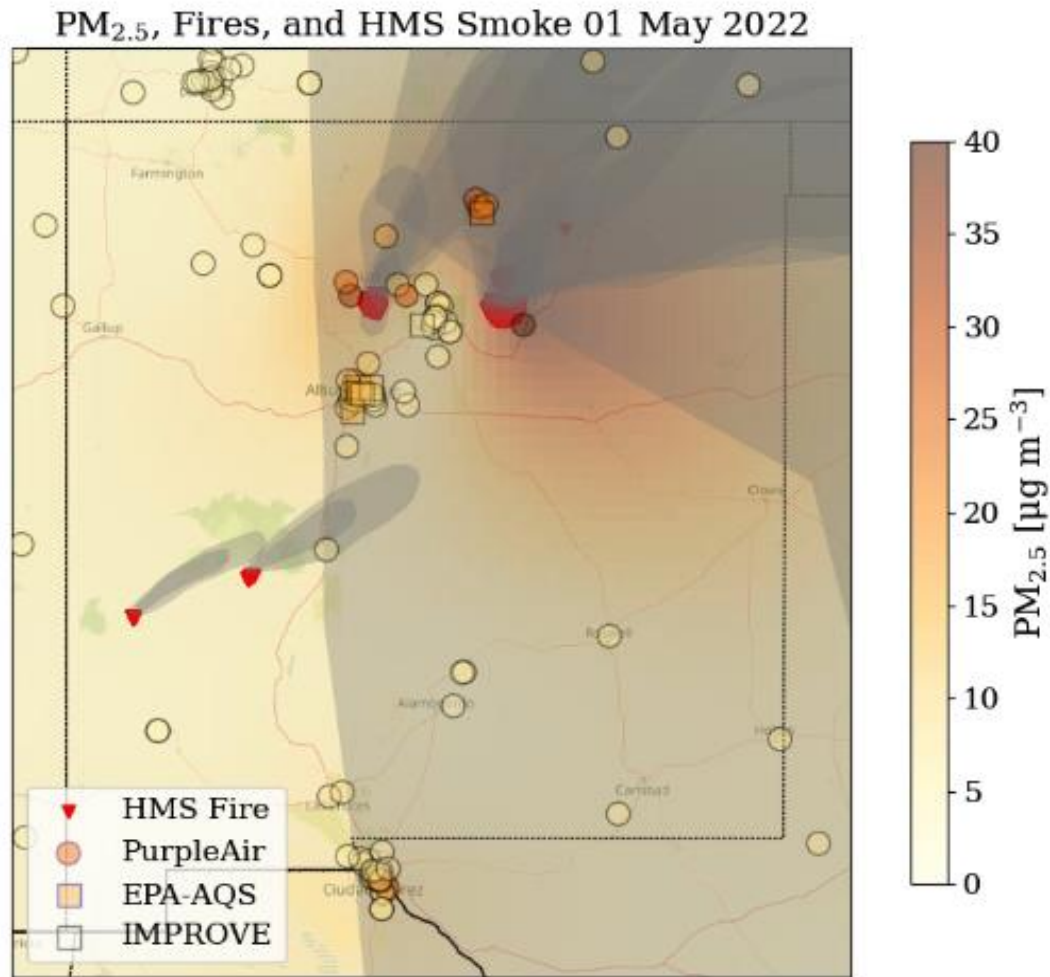


Two largest wildfires in state history:

- Calf Canyon/Hermits Peak Fire
- Black Fire



Rapid response project to quantify smoke $\text{PM}_{2.5}$ in New Mexico using low-cost sensors and satellite data.



Chris Uejio



Bonne Ford



Partners: New Mexico Department of Health

Thanks!