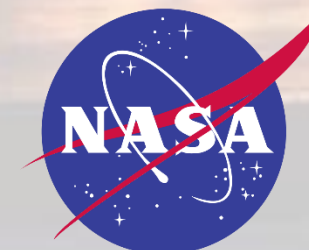
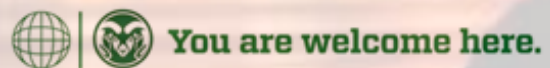


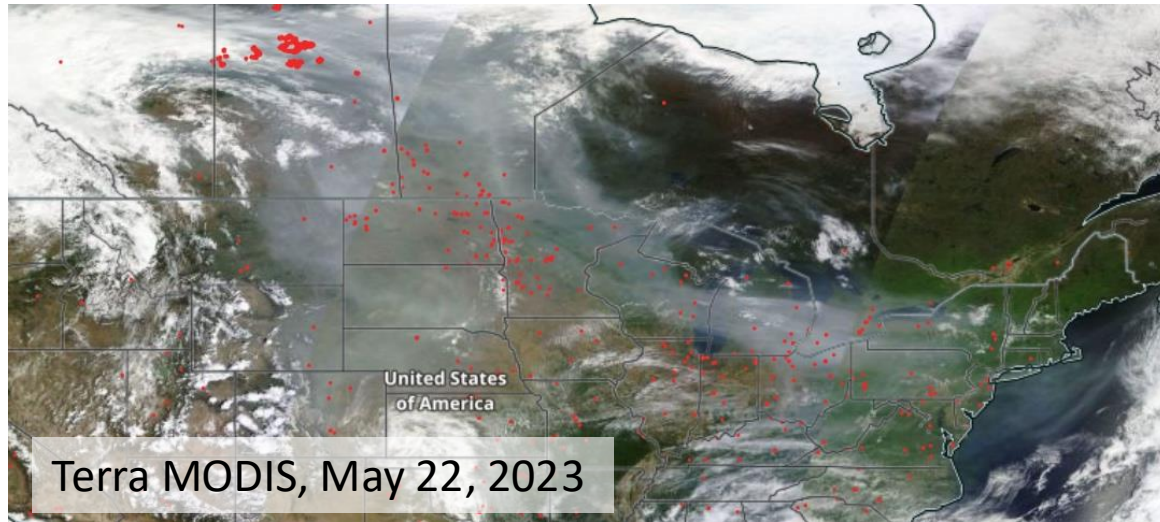
Satellite data for fires and smoke

Jeff Pierce

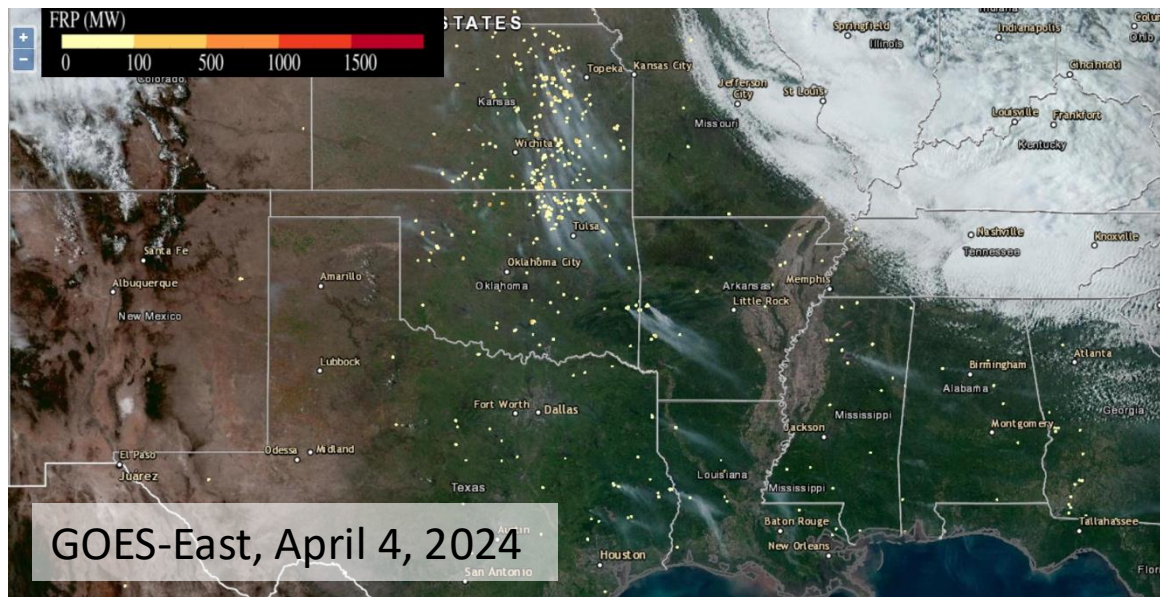
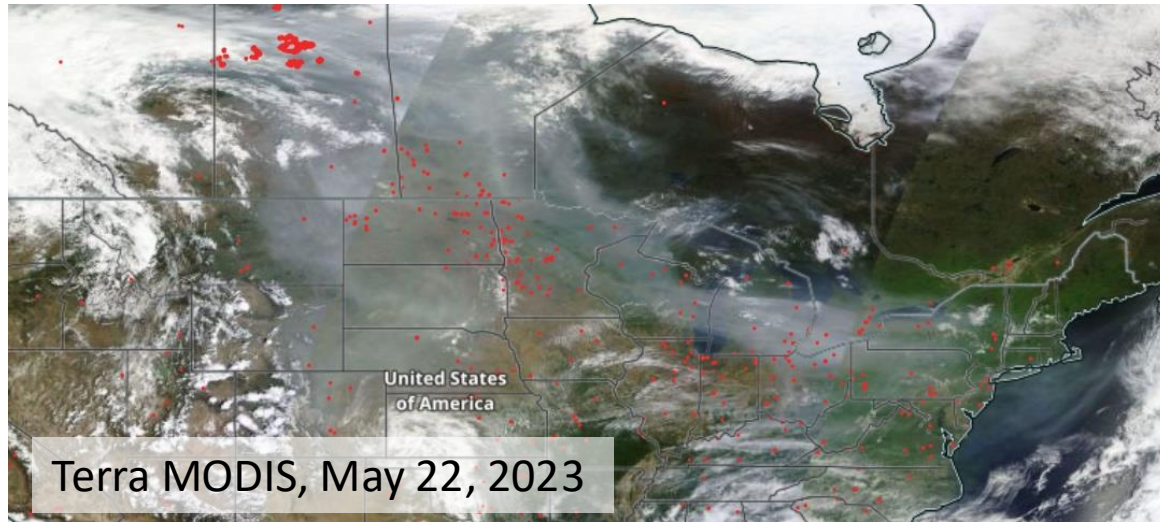
CSU, Atmospheric Science



Large wildfires and smoke are a continental problem.



Large wildfires and smoke are a continental problem. Smaller fires have important regional impacts.

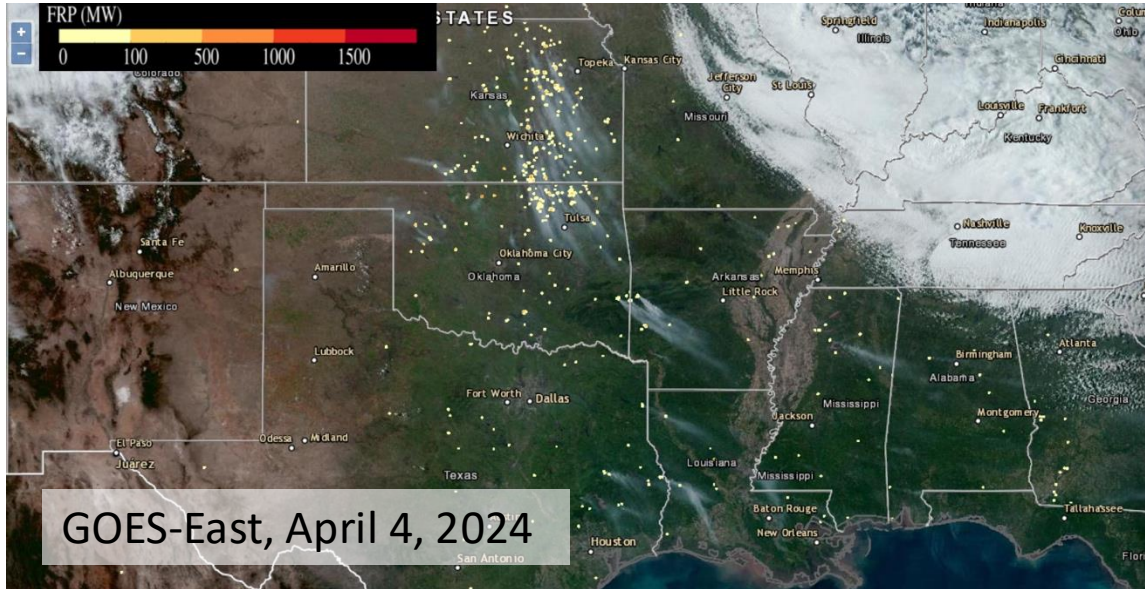


The HAQAST team uses Earth observations to answer the following questions:

- How much burned?
- How much smoke were people breathing?
- What are the health effects of smoke?
- Where is smoke going?

How much burned?

Small prescribed and agricultural fires are essential, but our understanding is limited.



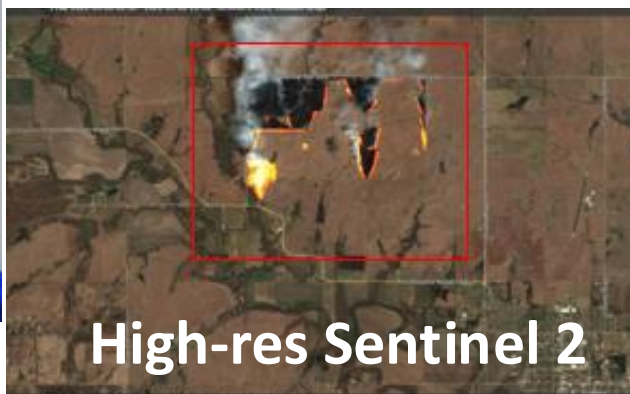
- Prescribed fire may decrease potential extreme wildfires, help ecosystems, or help agricultural productivity.
- Prescribed fire can be helpful, smoke is not.
- The total area burned from small prescribed fires often exceed or are equivalent to that of US wildfires.
- Small fires are NOT well defined in any of our emissions inventories due to reporting requirements and limitations traditional satellite instruments.
- New high-resolution data can quantify small fires.



Amber Soja



Emily
Gargulinski



NATIONAL
INSTITUTE OF
AEROSPACE



HAQAST Tiger Team identified larger areas of prescribed fire than previously estimated.

Using high-resolution burn-scar images from satellites:

- Depending on the ecosystem, active fire detections only capture 30 – 47% of the number of active fires.
- Active fire detections only capture 14 – 65% of the burned area.

High-resolution satellites (e.g., Sentinel) allow for more complete characterization of small fires.

These satellites will help with:

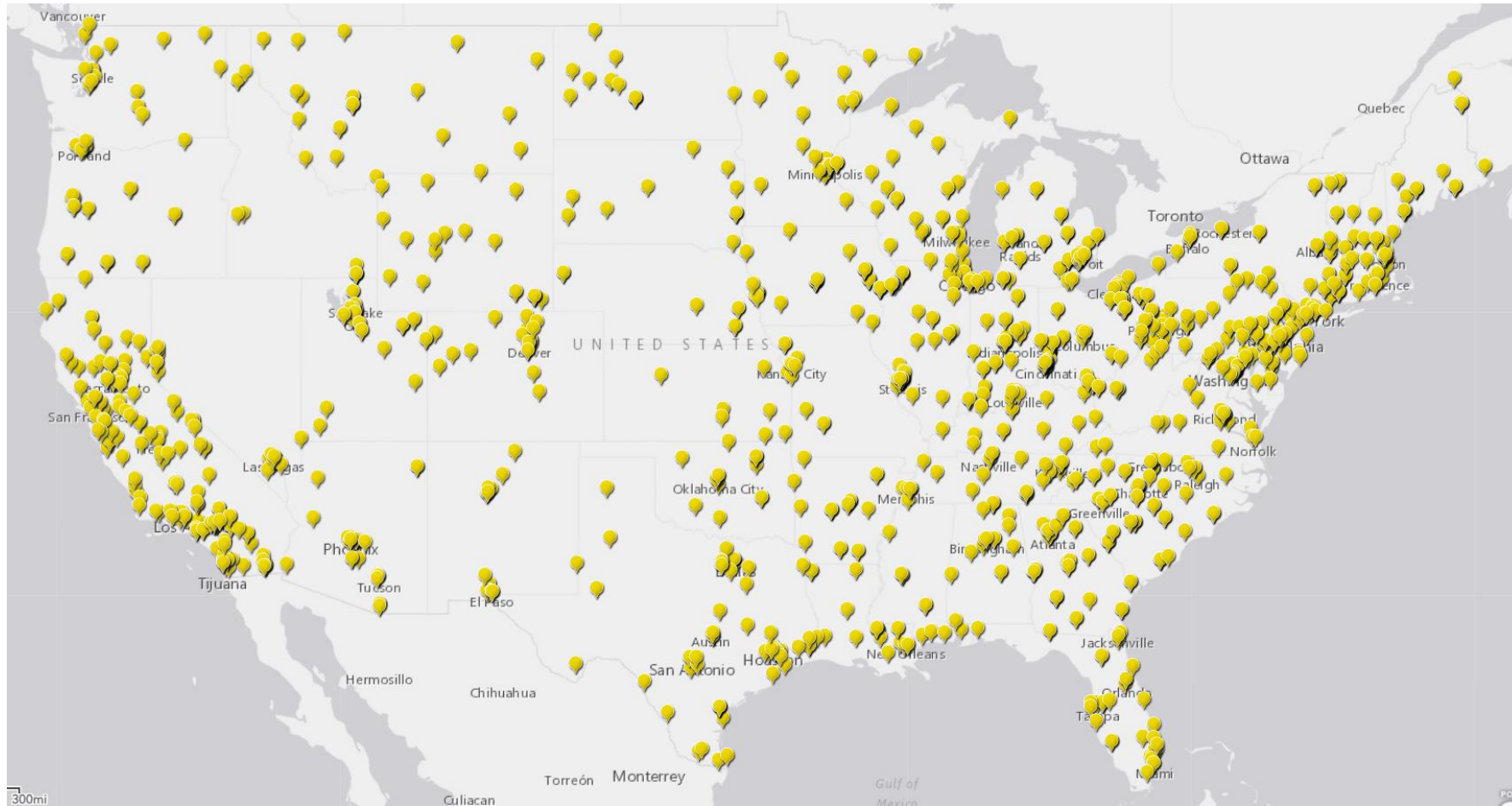
- Emission inventories
- Health studies
- Ecosystem studies



For more, please see: Amber Soja (NASA)
and Sherri Hunt (EPA)
from 2:00-4:00, Session 4

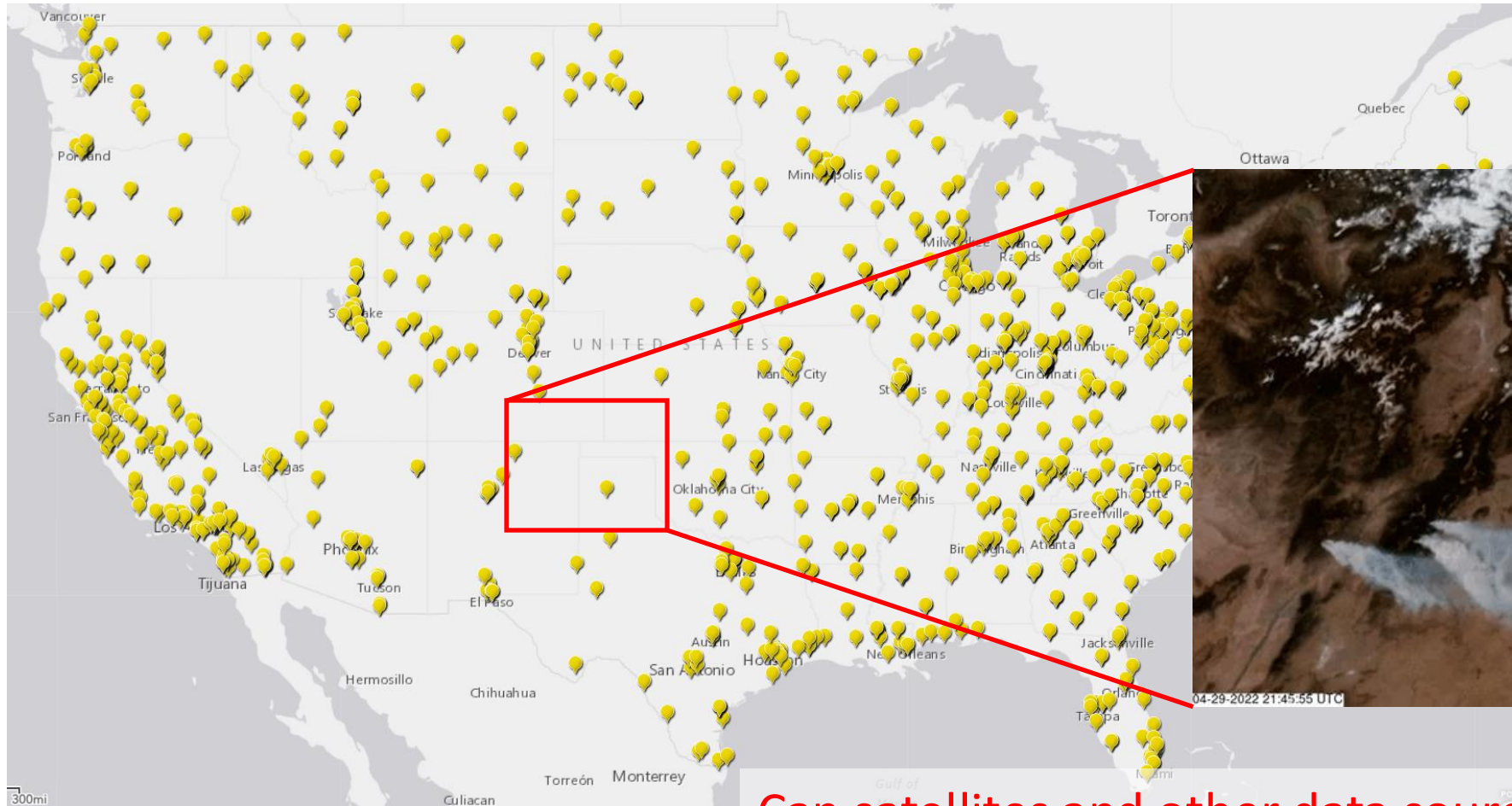
How much smoke were
people breathing?

The US has the most extensive network of regulatory particulate matter monitors in the world.

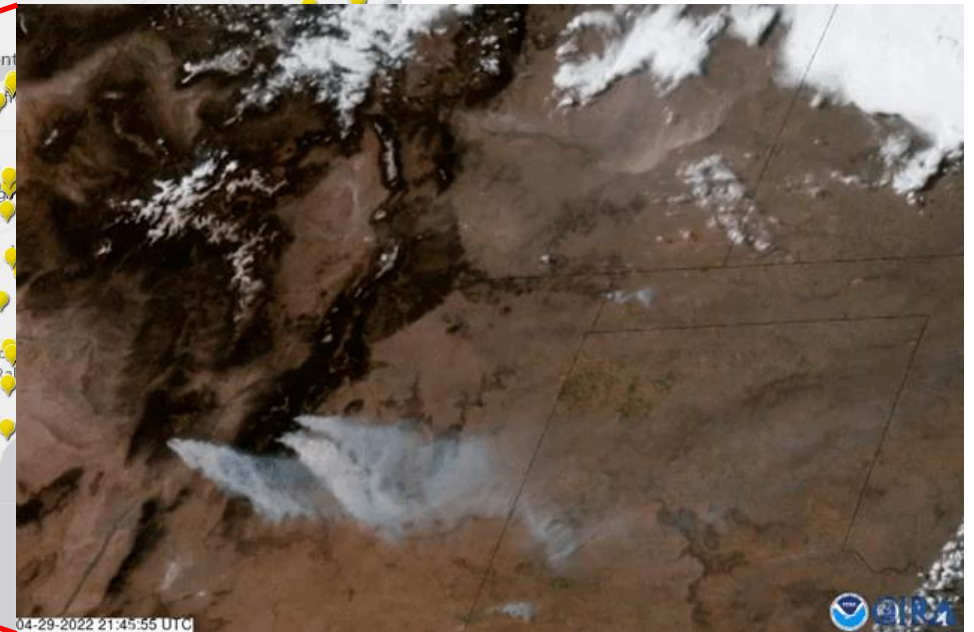


Active regulatory PM_{2.5} monitors.

The US has the most extensive network of regulatory particulate matter monitors in the world...
but it's insufficient for smoke plumes!

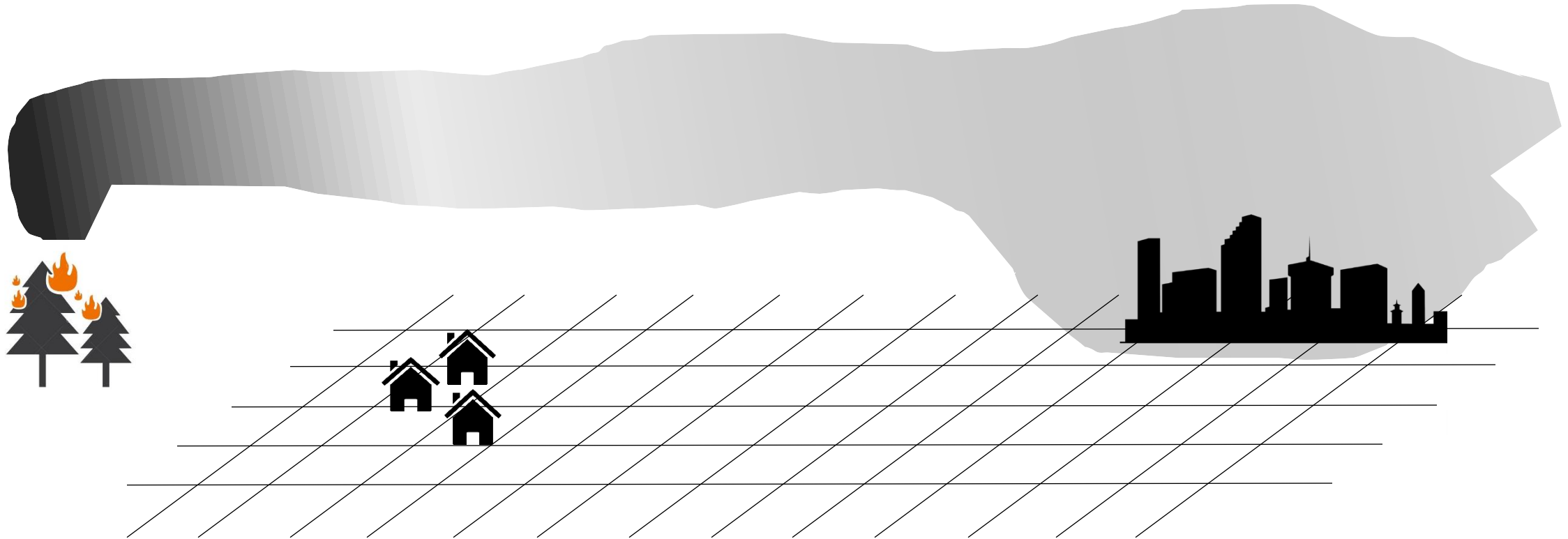


Active regulatory PM_{2.5} monitors.



Can satellites and other data sources help?

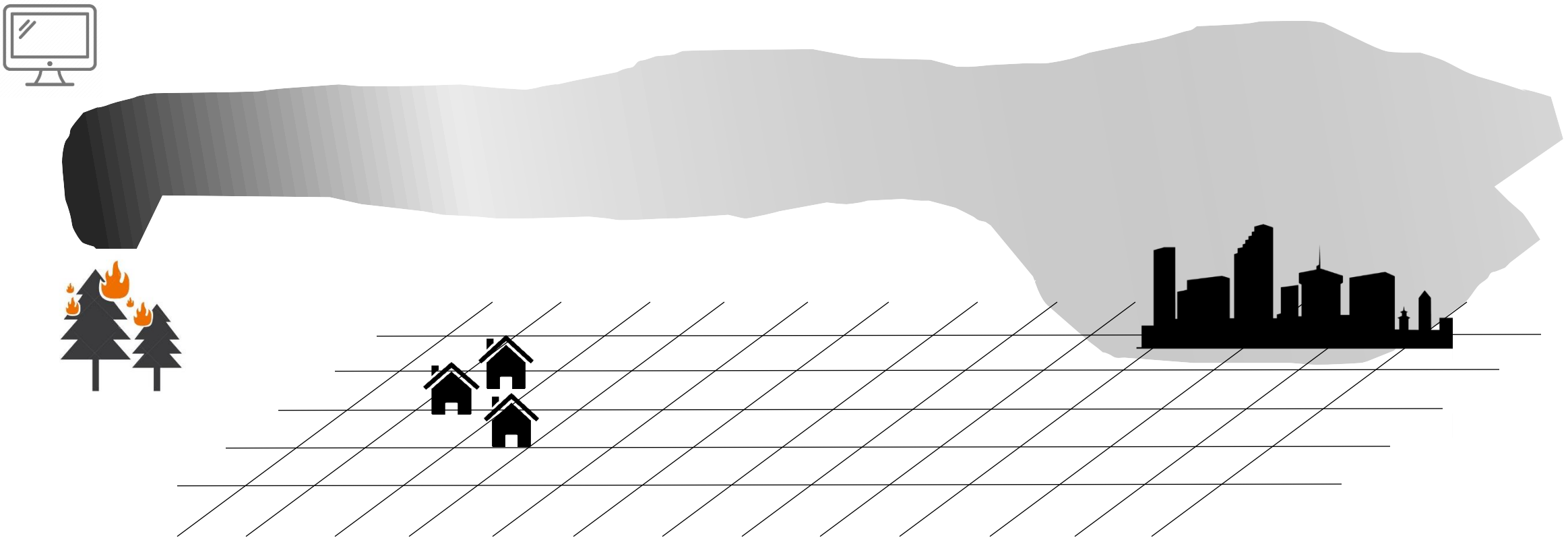
The HAQAST team is combining information sources to understand smoke.



Slide courtesy of Emily Fischer

The HAQAST team is combining information sources to understand smoke.

Weather models with smoke: Prone to errors in smoke emissions and transport.



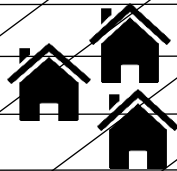
Slide courtesy of Emily Fischer

The HAQAST team is combining information sources to understand smoke.

Weather models with smoke: Prone to errors in smoke emissions and transport.



Satellites – Can detect the plumes spatial extent, but don't precisely give surface concentrations.



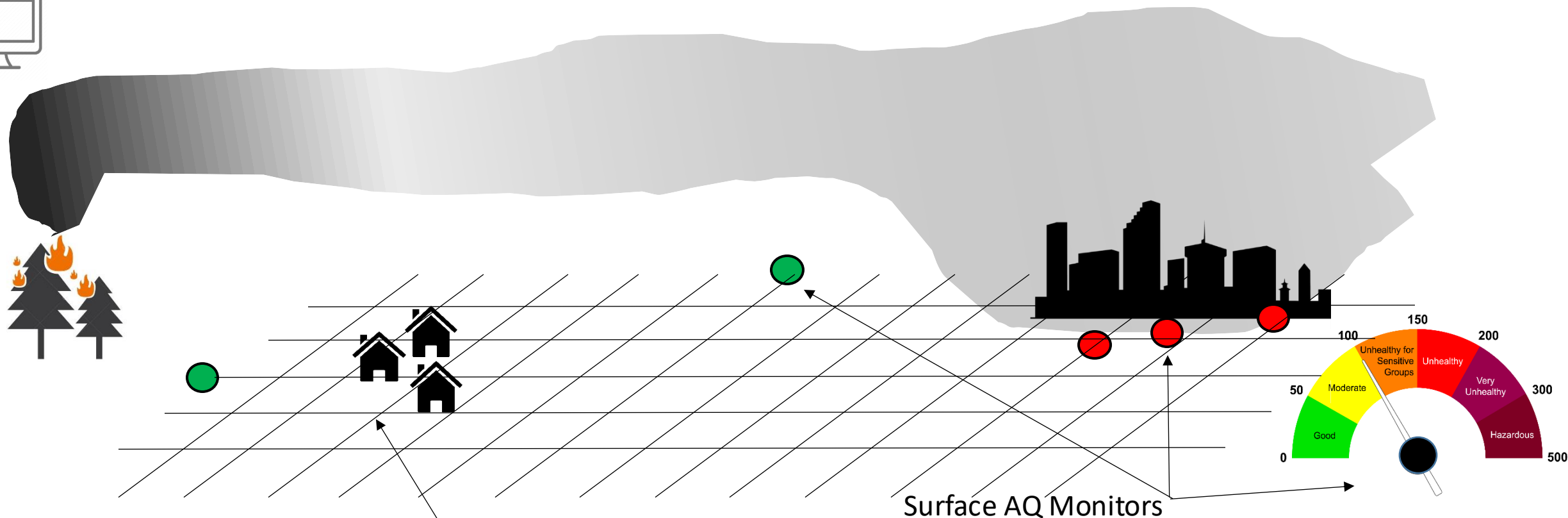
Slide courtesy of Emily Fischer

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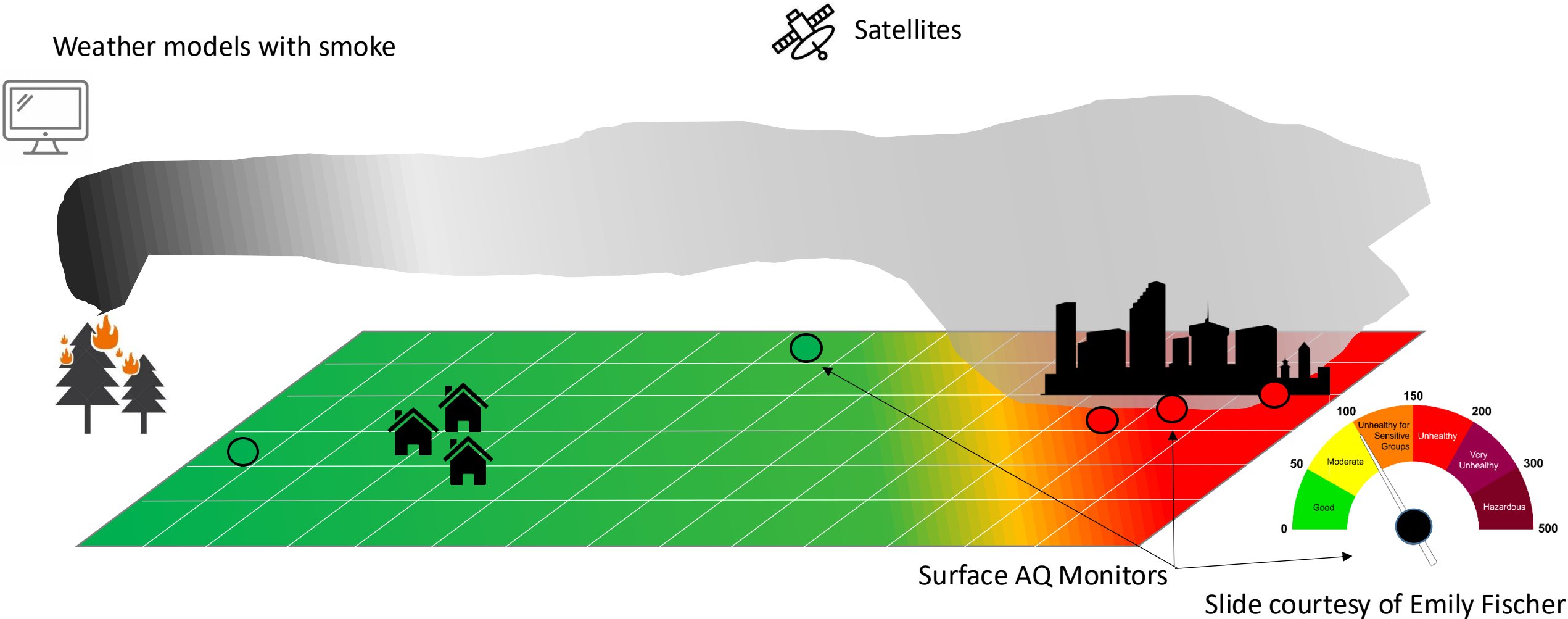


We need to know AQ everywhere where people live, work and play - not just near the monitors!

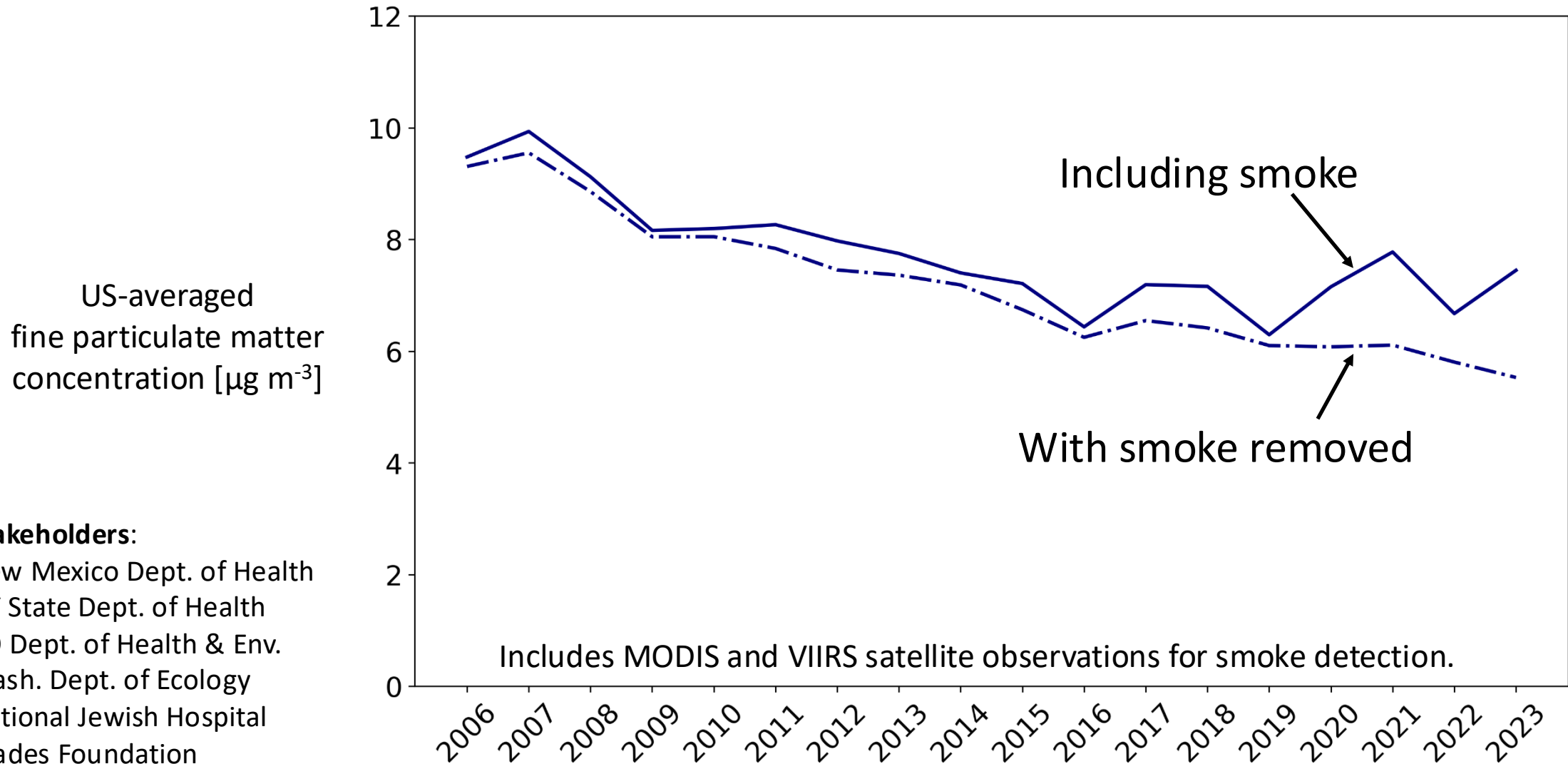
Surface AQ Monitors
(note these are sparse)

Slide courtesy of Emily Fischer

Combine the strengths of all of the data sources to quantify smoke everywhere!



Using this combined technique, we show that smoke has stalled improvements in US particulate matter.



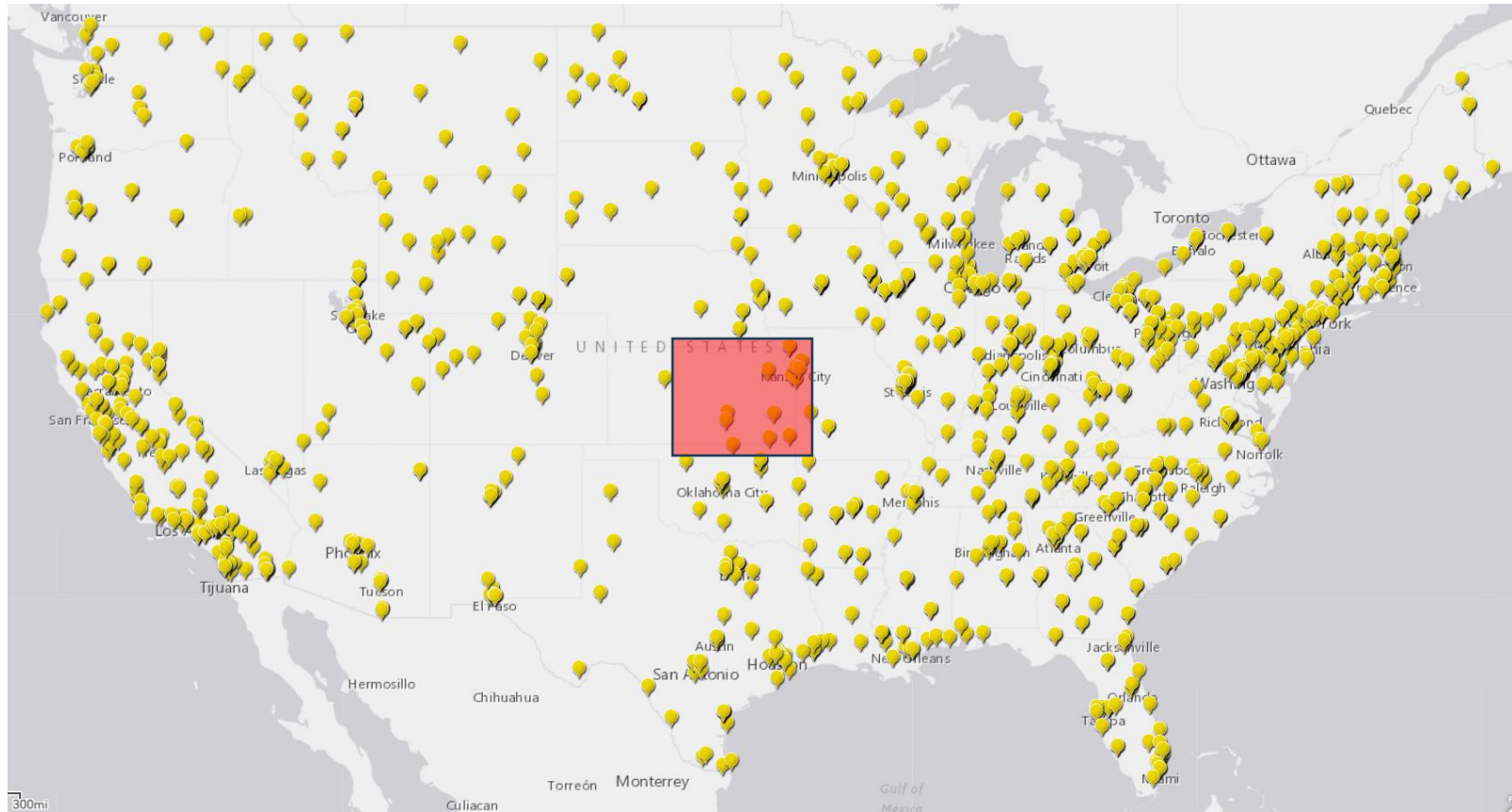
Stakeholders:

New Mexico Dept. of Health
NY State Dept. of Health
CO Dept. of Health & Env.
Wash. Dept. of Ecology
National Jewish Hospital
Glades Foundation
Department of Veteran Affairs



Figure by Jennifer McGinnis

Prescribed fire Tiger Team: Kansas



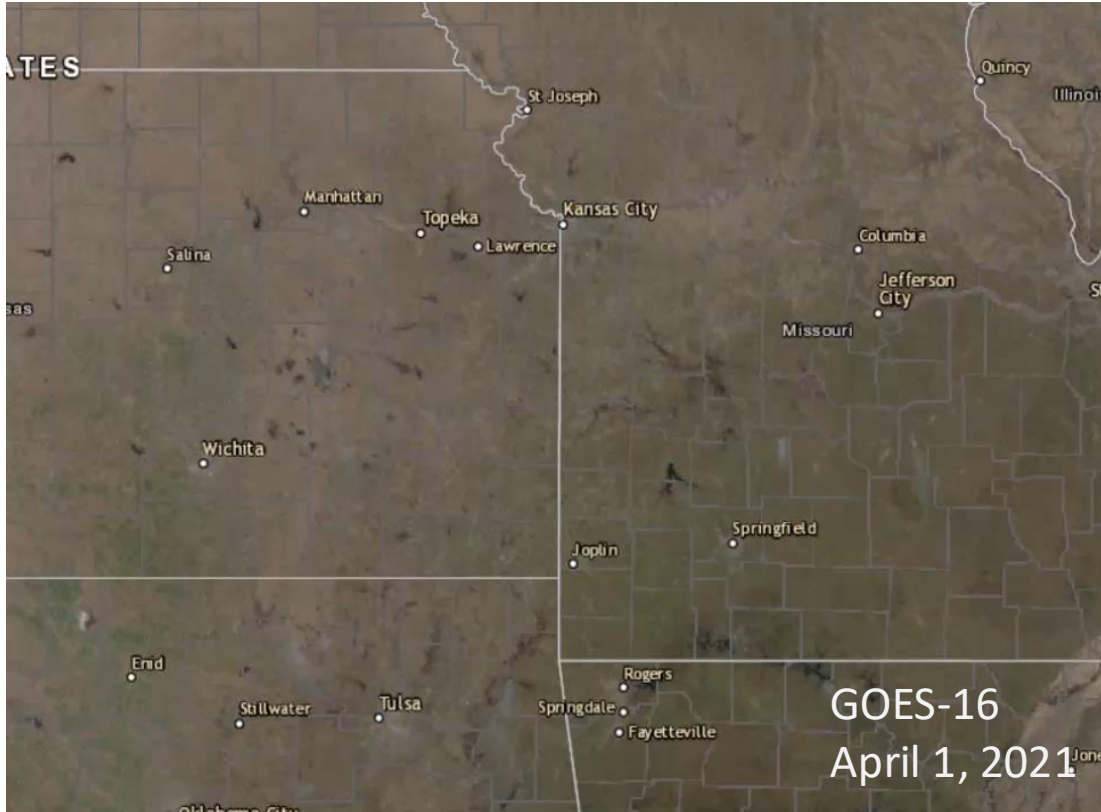
Annual springtime prescribed burning



Partners: Kansas Department of Health and Environment, community partners

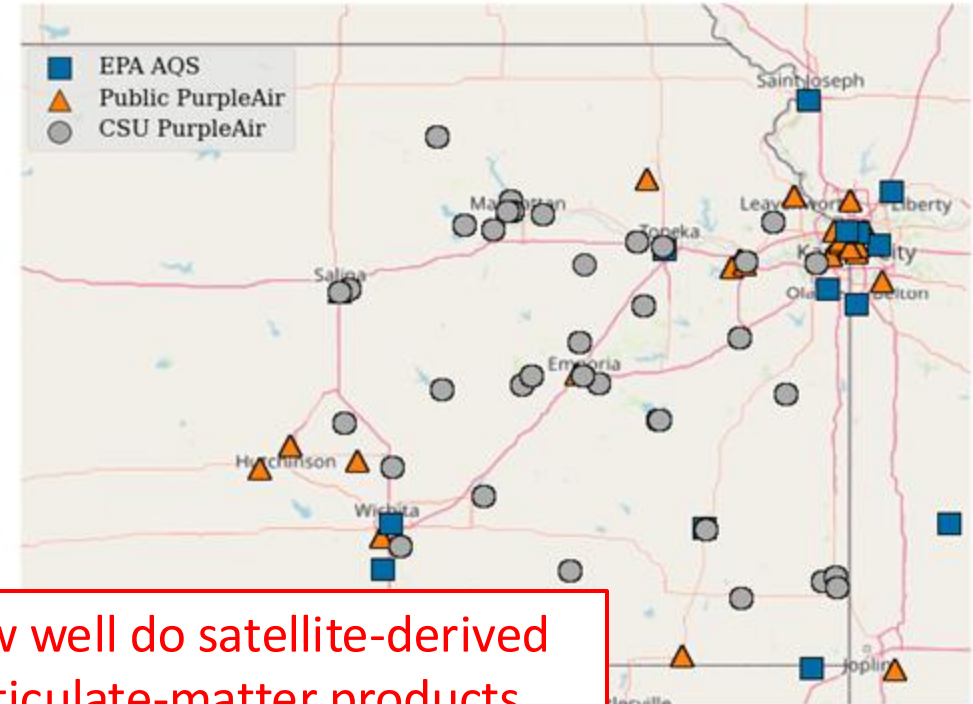
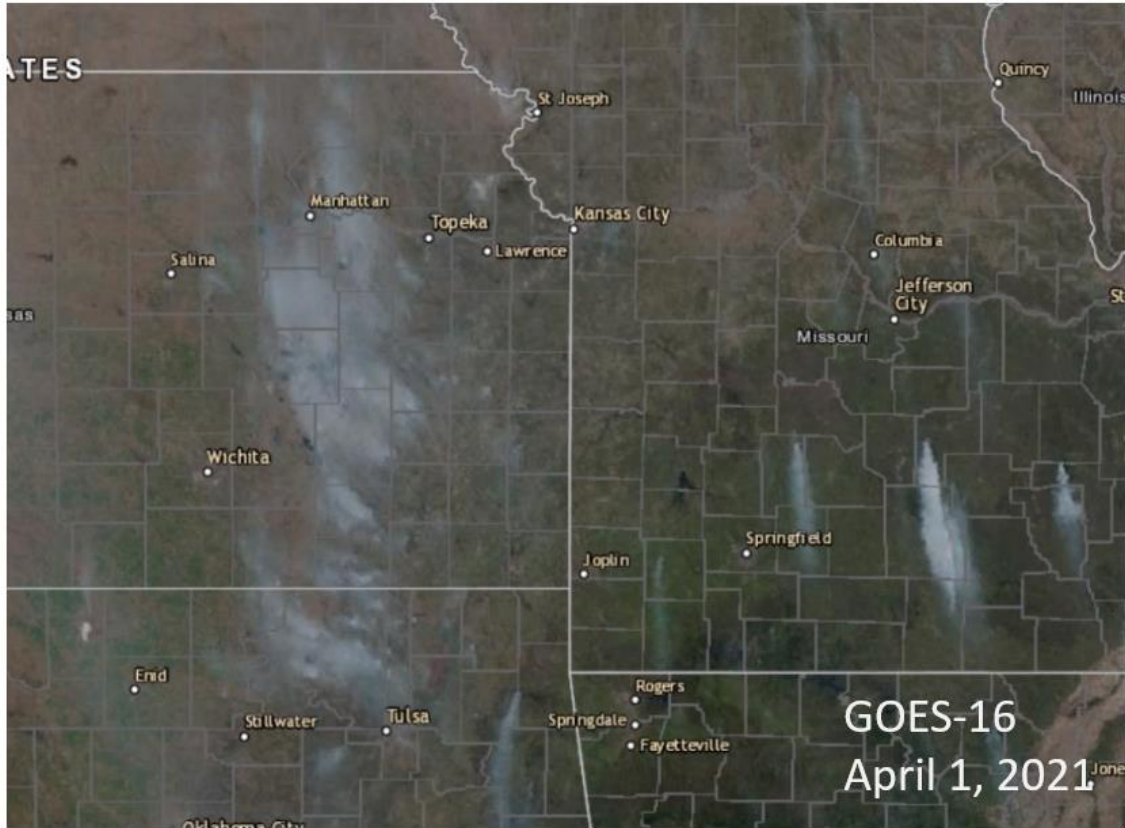
Sheryl Magzamen Amber Soja

Prescribed fires in the Flint Hills are away from the regulatory monitors.



Partners: Kansas Department of Health and Environment,
community members

We incorporated low-cost monitors understand the smoke away from regulatory monitors.



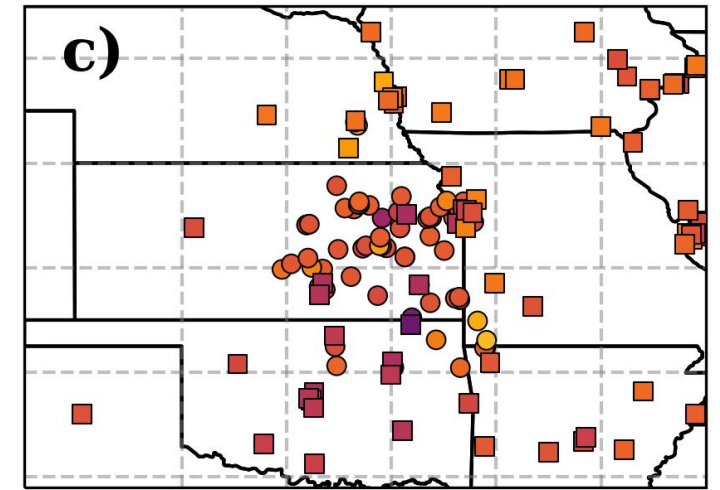
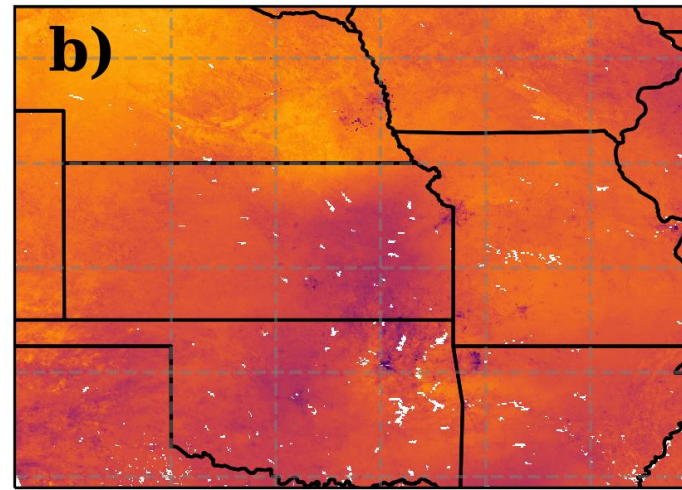
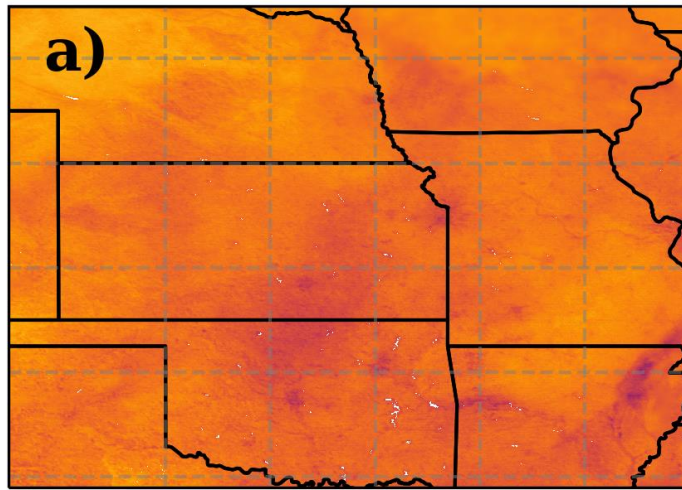
How well do satellite-derived particulate-matter products quantify smoke in this region?

Satellite-derived particulate-matter products capture the springtime smoke in eastern KS.

2022 Martin Group

2022 GOES

2022 Daily PM_{2.5}



100°W 96°W 92°W
Includes MODIS and VIIRS satellite observations

100°W 96°W 92°W

100°W 96°W 92°W



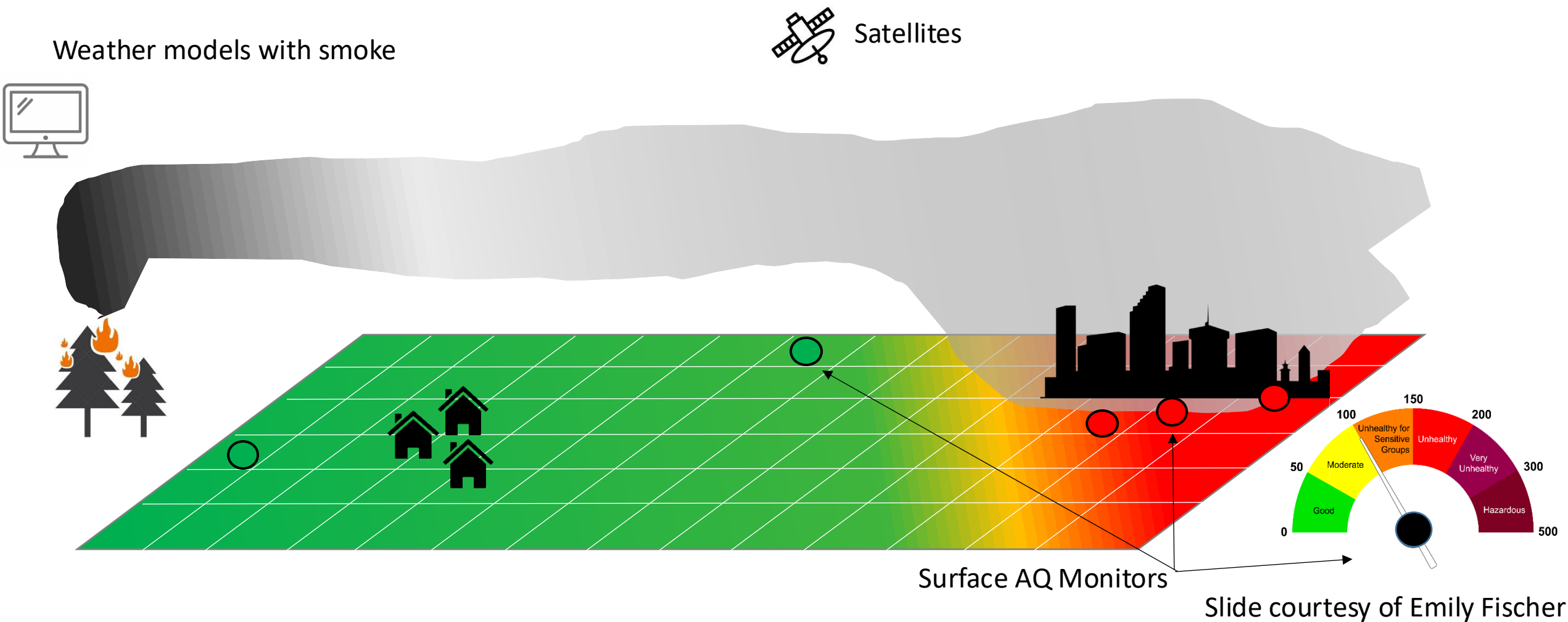
PM_{2.5} (µg /m³)

■ EPA
● PurpleAir



What are the health effects
of smoke?

HAQAST researchers build off of the smoke estimates to understand how health outcomes change when smoke arrives.



The HAQAST team leads studies to understand the health effects of smoke/fires

- Cancer
- Mortality
- Respiratory hospital visits/admissions
- Inhaler refills
- Anxiety & mental health
- Birth outcomes
- Rheumatoid arthritis
- Domestic violent crimes

Sheryl Magzamen



For more, please see:
Sheryl and Yang's talks
later today

Stakeholders:

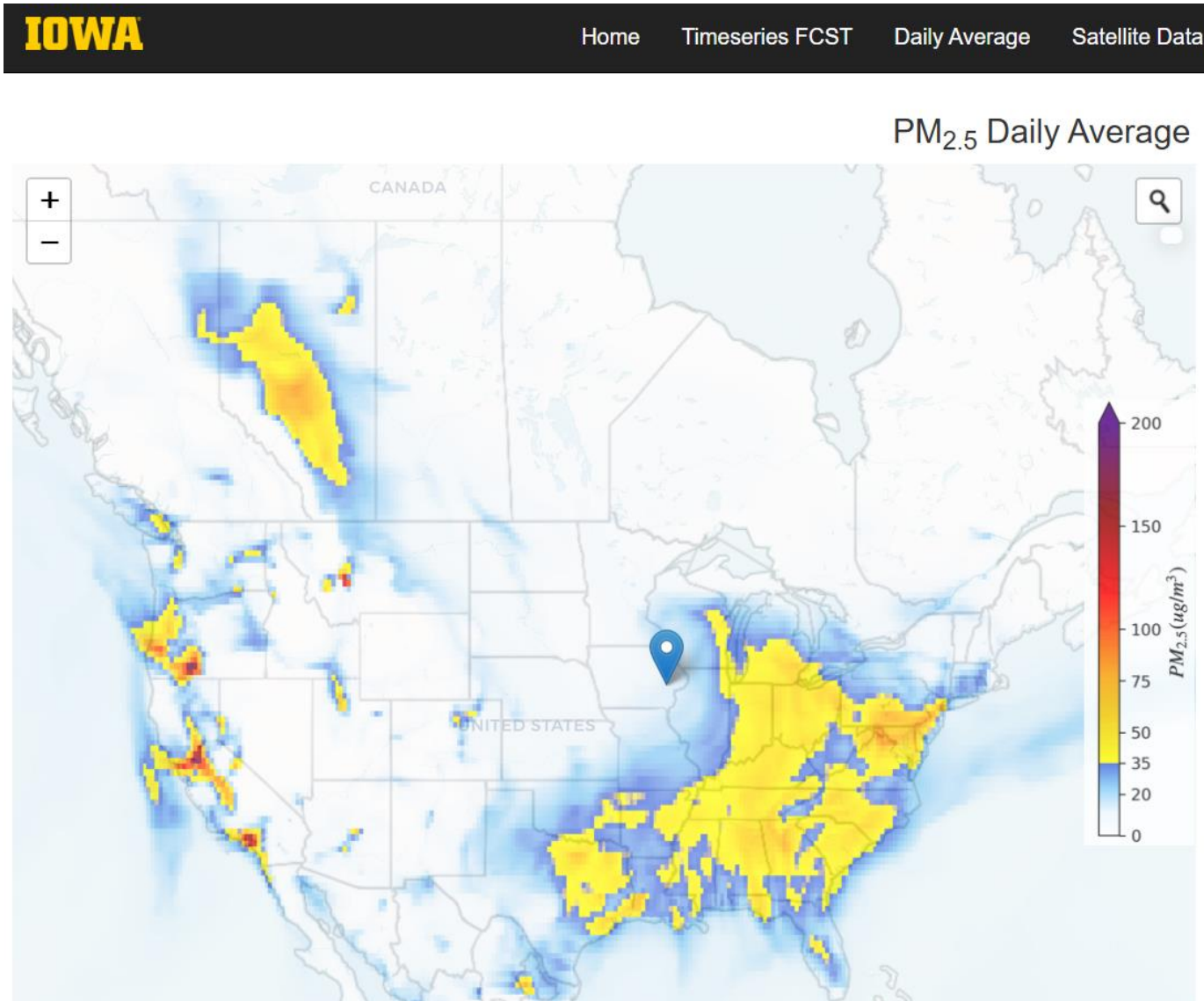
American Cancer Society
Dept. of Veteran Affairs
National Jewish Hospital
New Mexico Dept. of Health
NY State Dept. of Health
CO Dept. of Health & Env.
Wash. Dept. of Ecology

Yang Liu



Where will smoke be?

Development of an easy user interface for NASA's smoke/pollution forecasts



Uses NASA's GEOS-FP and GEOS-CF forecast products informed by satellites.
Includes satellite imagery.

Stakeholders:

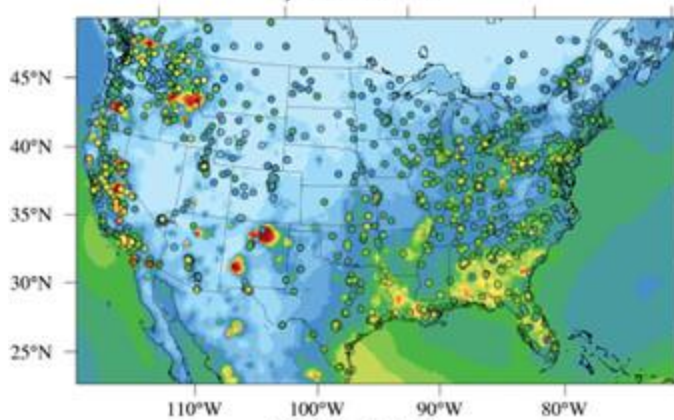
Lake Michigan Air Directors Consortium (LADCO)
Maine Department of Environmental Protection
South Coast Air Quality Management District
Colorado Department of Public Health & Environment
Oklahoma Department of Environment Quality.



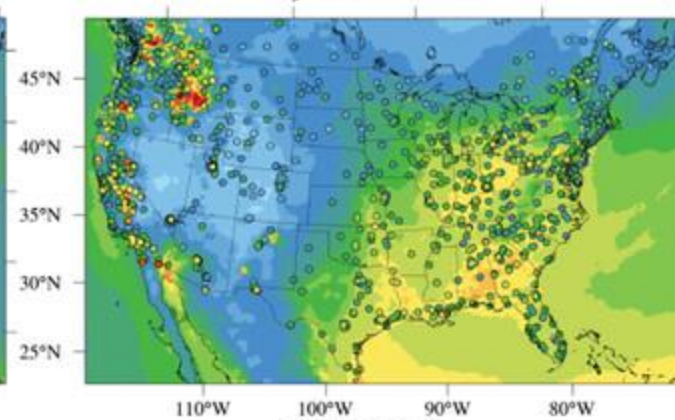
Jun Wang, University of Iowa

Smoke forecast predictions vary greatly.

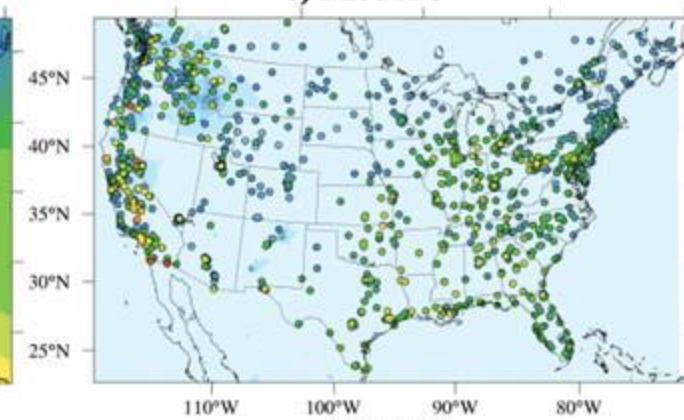
a) Model-1



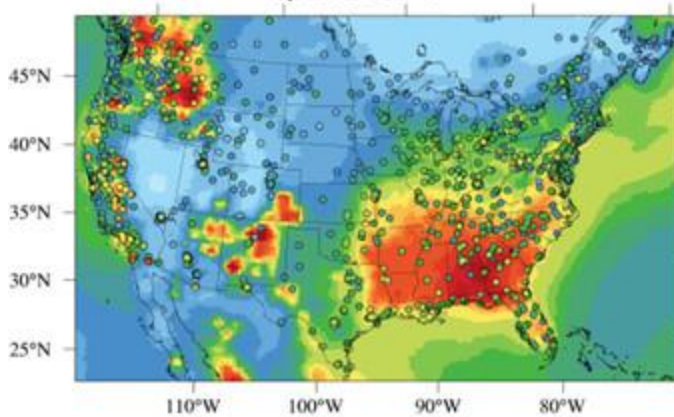
b) Model-2



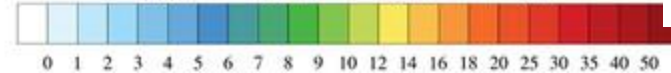
c) Model-3



d) Model-4



e) Model-5



Includes NASA's GEOS-FP forecast product informed by satellites.

Stakeholders: State agencies, EPA, WMO, Kaiser Permanente

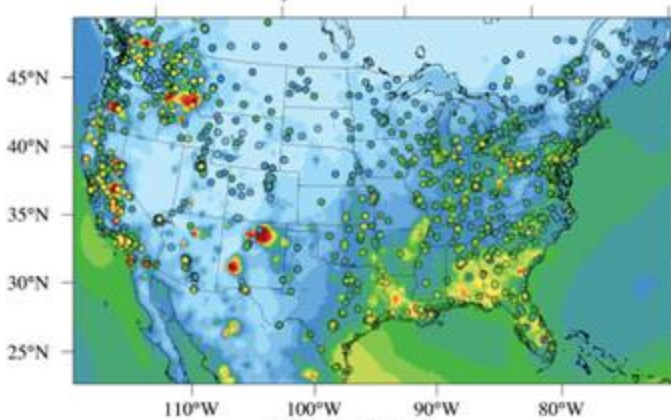
Li et al., BAMS, 2024.

Daniel Tong

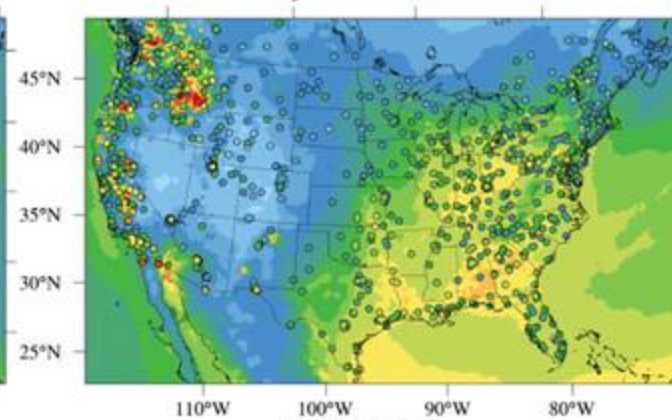


Combining smoke forecasts improves smoke predictions greatly!

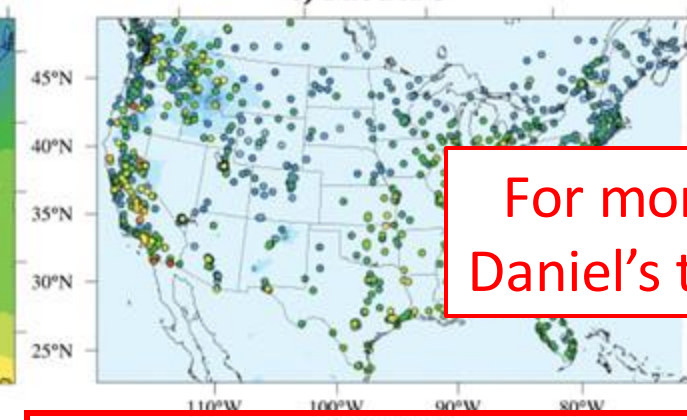
a) Model-1



b) Model-2

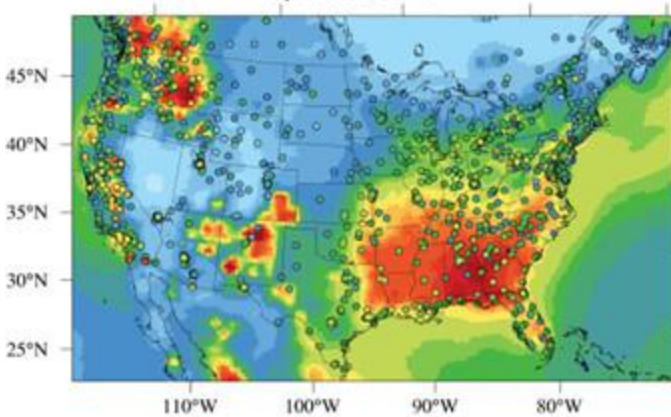


c) Model-3



For more, please see:
Daniel's talk in Session 3

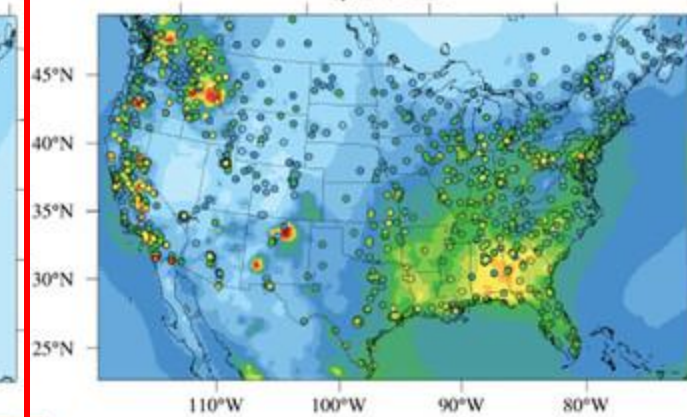
d) Model-4



e) Model-5



f) MMA



Includes NASA's GEOS-FP forecast product informed by satellites.

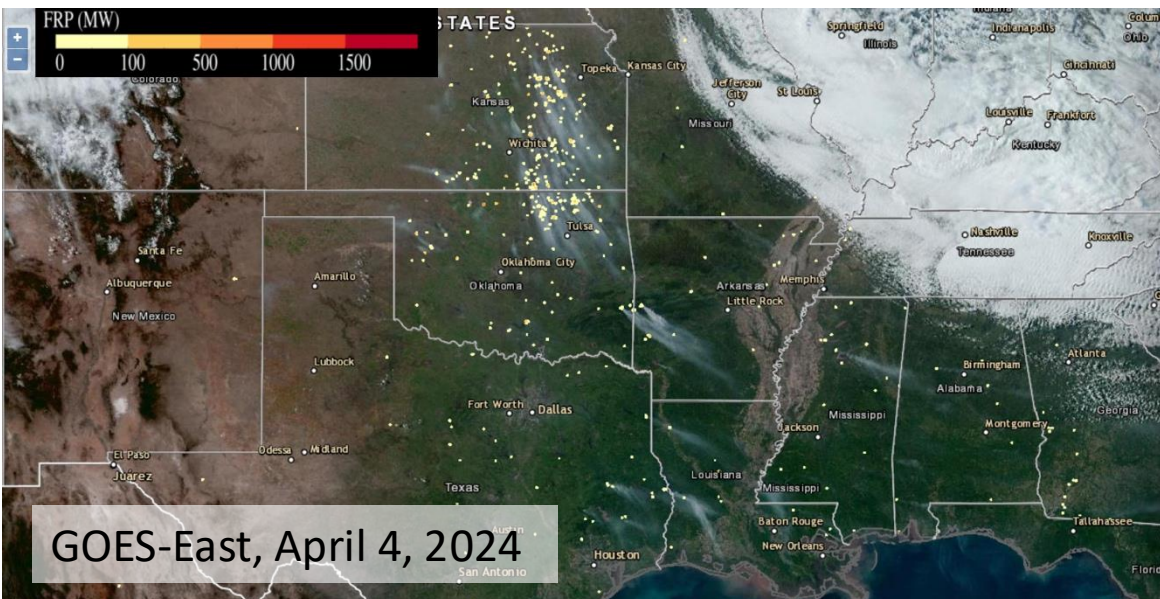
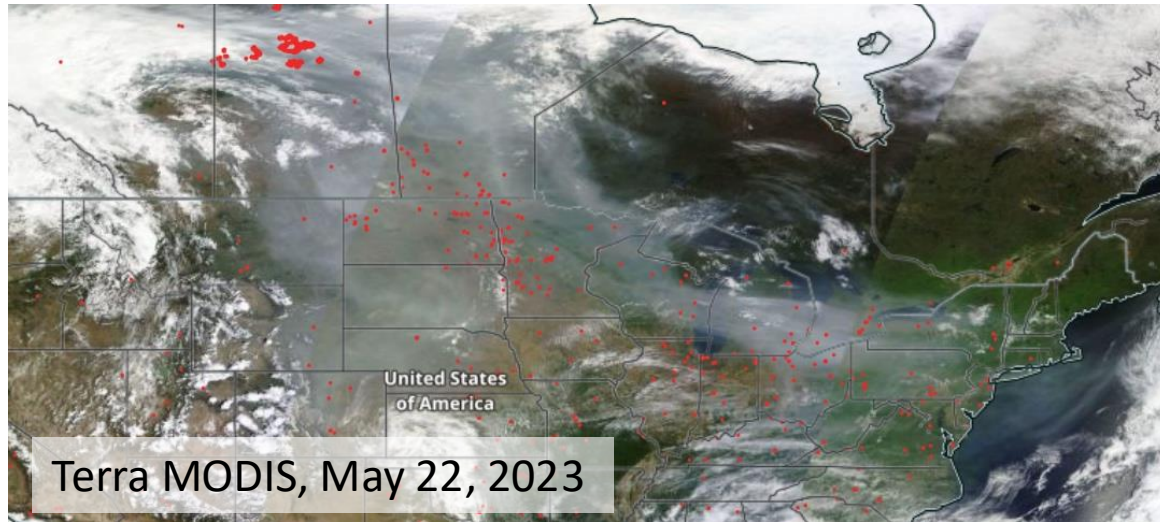
Li et al., BAMS, 2024.

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Daniel Tong



Thanks!



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