Air Pollution in the US

remembering,
understanding,
anticipating

Professor Ann Marie Carlton | Univ. of California

Chester Higgins, Jr. 1973

Wikimedia

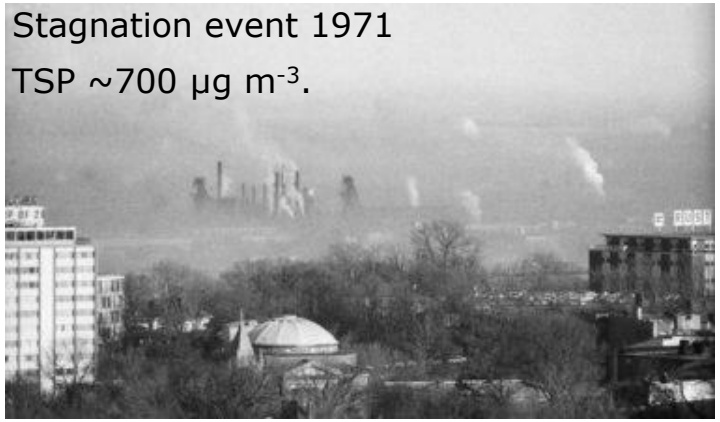
BRAVE NEW FILMS
LOS ANGELES
SMOG, 1954
LOS ANGELES
TODAY
THANKS TO
ENVIRONMENTAL
REGULATIONS

The emissions that affect air quality, impact climate. What are the lessons learned?

CLIMATE WEEK NYC
CLIMATE GROUP

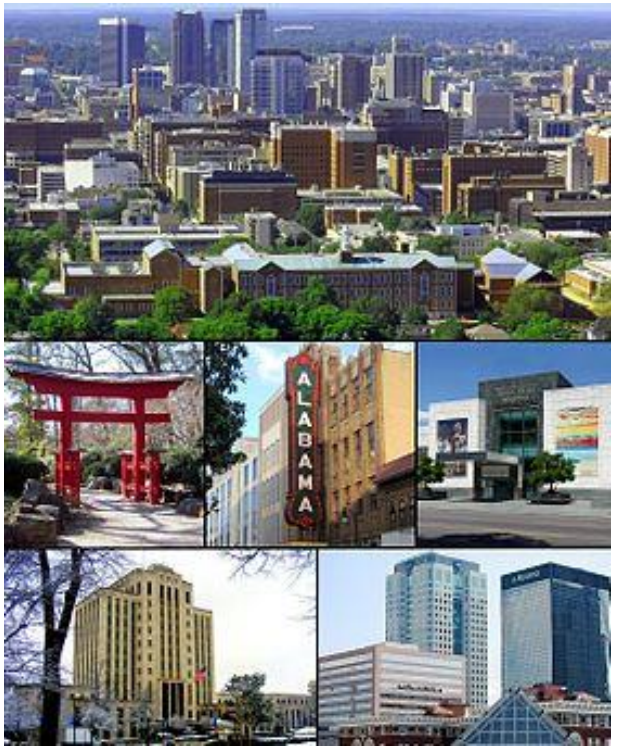
Remembering

Birmingham, AL: bastion of social change in the U.S.



The Birmingham News file/Dave Battle

EPA's first implementation of the CAA's "emergency powers" provision.



40 years later EPA proposed Birmingham be certified as having attaining National Ambient Air Quality Standards (NAAQS)

US Air Pollution Regulation

Clean Air Act (CAA) of 1963*

Motor Vehicle Air Pollution Control Act of 1965

Air Quality Act of 1967

Clean Air Amendments of 1970* Creation of EPA

CAA Amendments of 1977

CAA Amendments of 1990

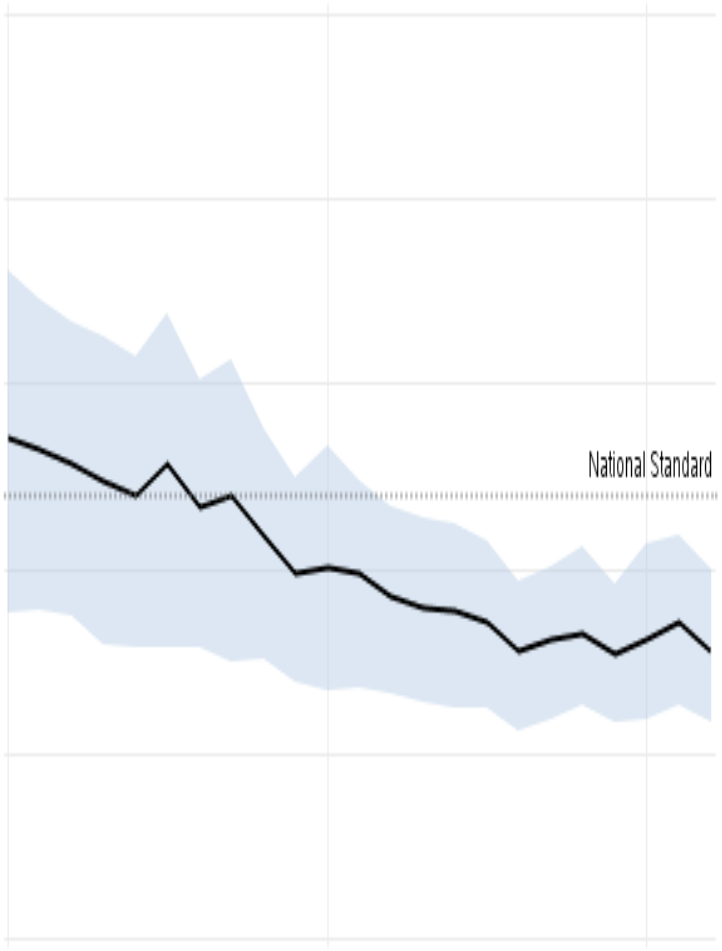
Inflation Reduction Act 2023: CO_2 is a CAA pollutant

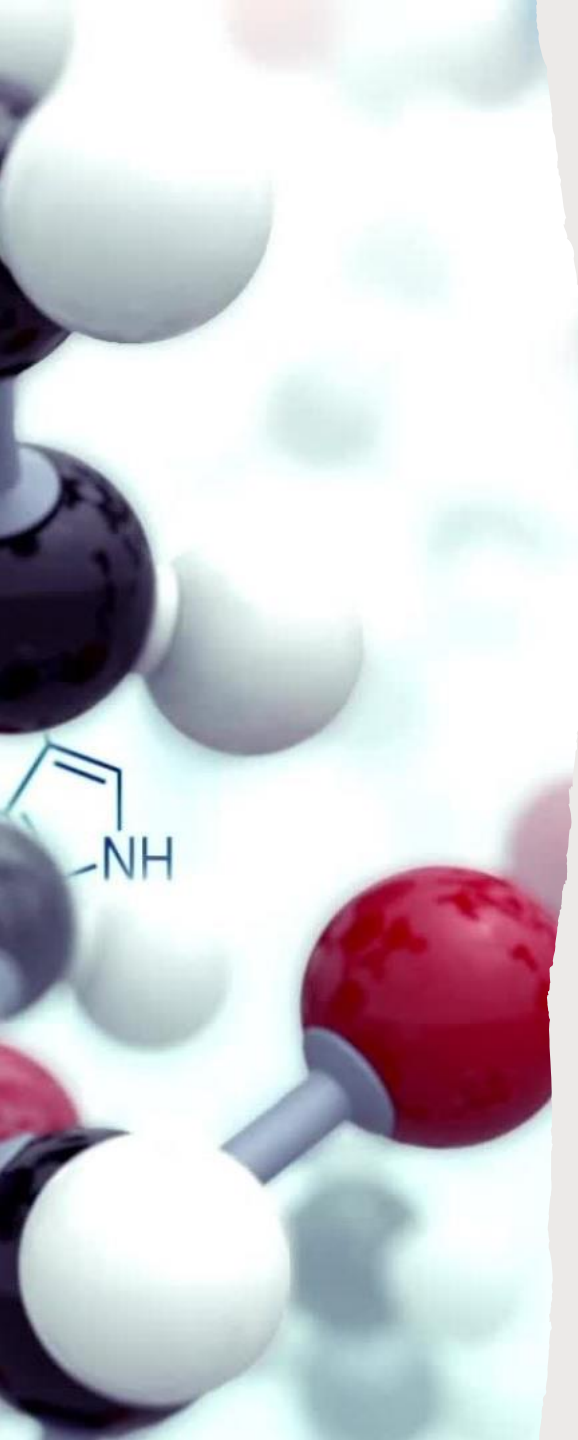
EPA promulgates standards that define what CAA/CAAA means

"Command & Control" or "Performance Standards"

"Cap & Trade" or Pollutant Trading

Airshed approach: "criteria" air pollutants

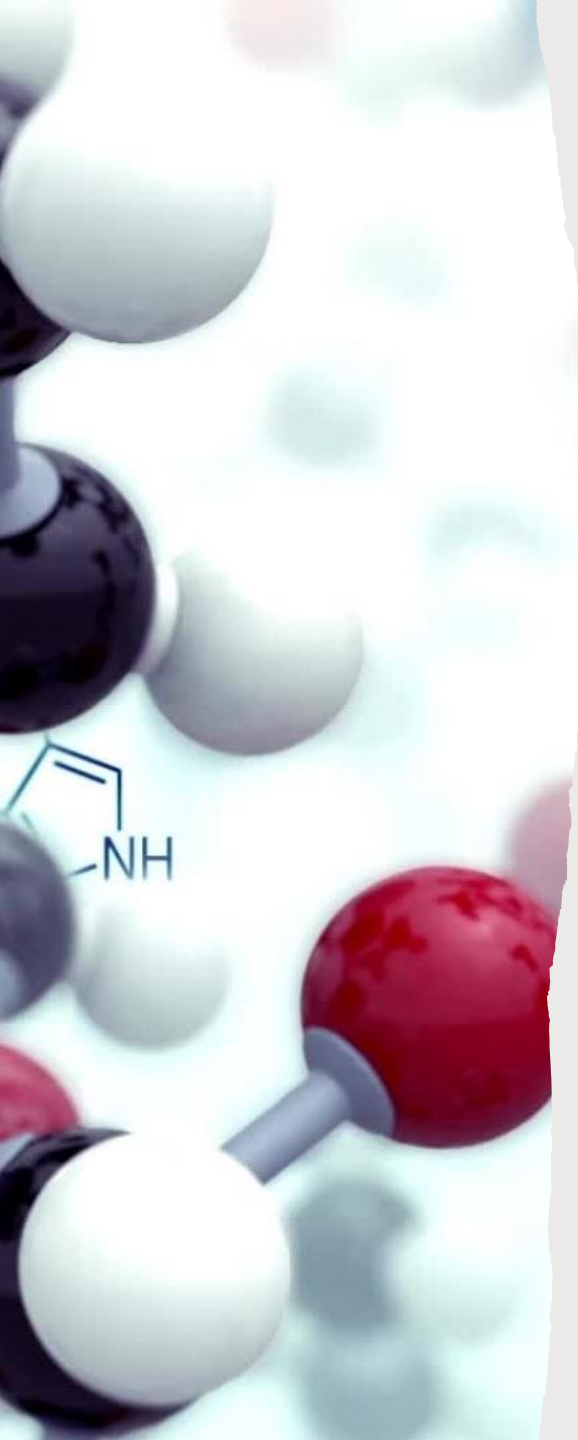




Criteria Pollutants

Carbon Monoxide
Lead
Sulfur Dioxide
Nitrogen Dioxide

Ground-level ozone
Particulate matter



Criteria Pollutants

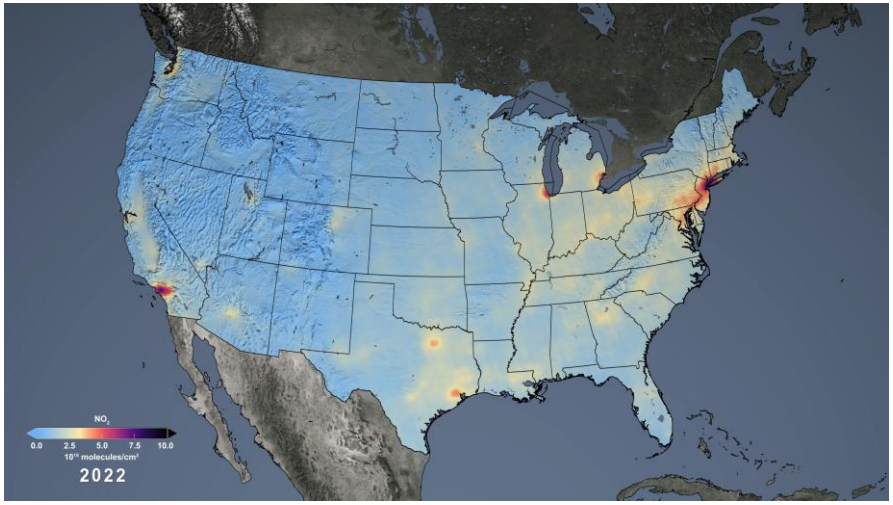
Carbon Monoxide
Lead
Sulfur Dioxide
Nitrogen Dioxide

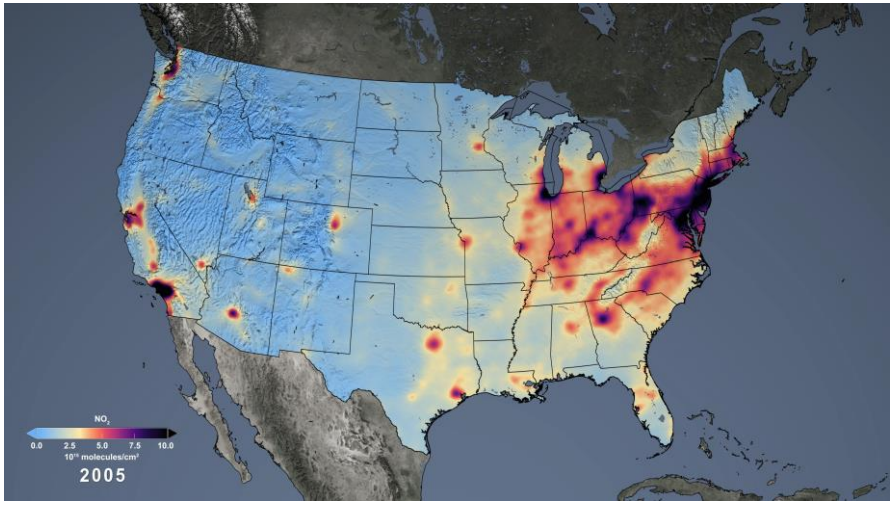
} directly emitted

Ground-level ozone
Particulate matter

} forms in atmosphere from precursors

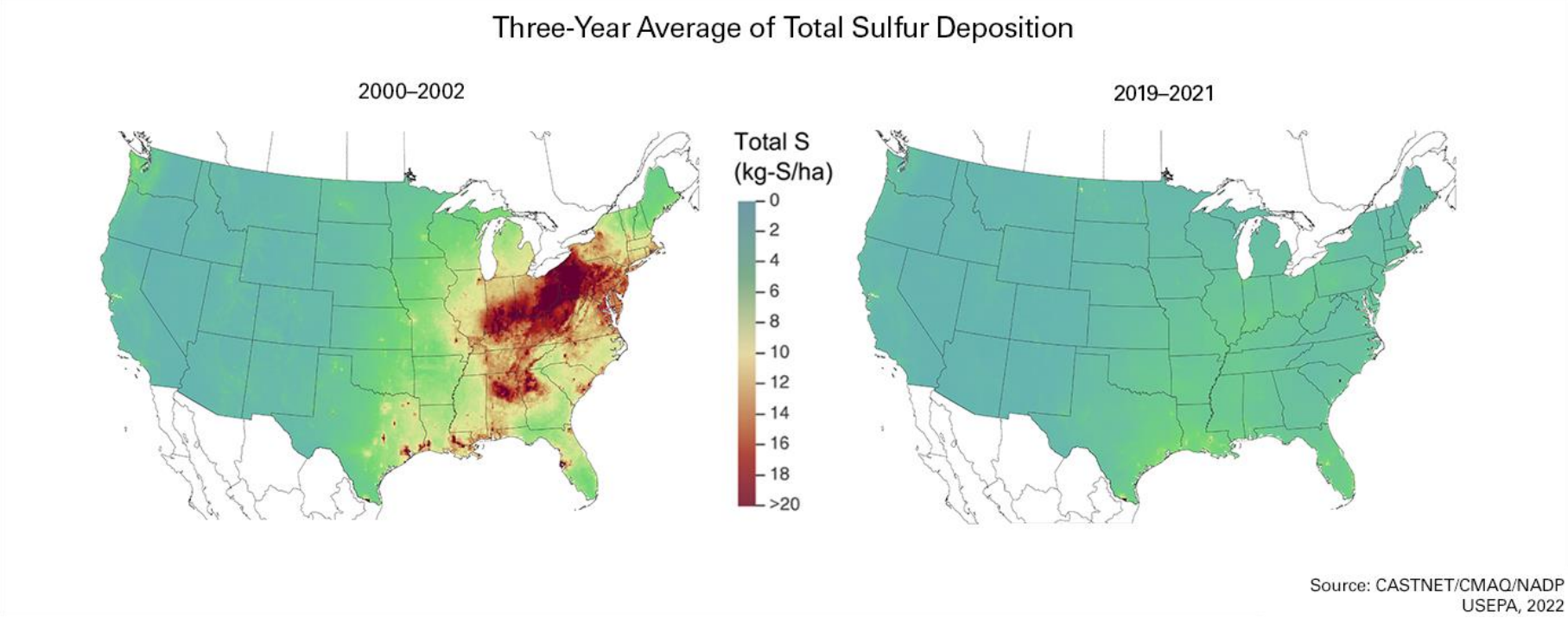
State Autonomy: meet airshed values, when in "non-attainment" States prepare State Implementation Plans (SIPs) demonstrating how they will attain the standard





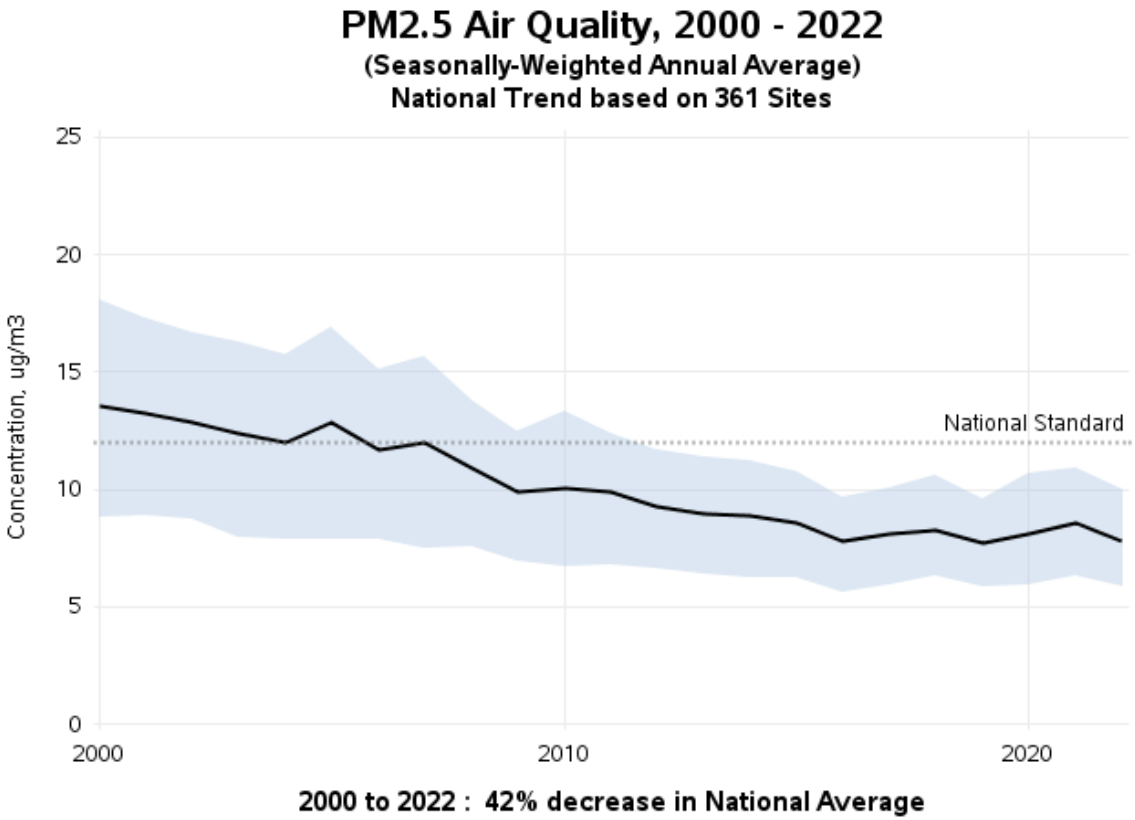
NASA detects reduction in NO_2 burden with remarkable fidelity

Acid Rain Rules



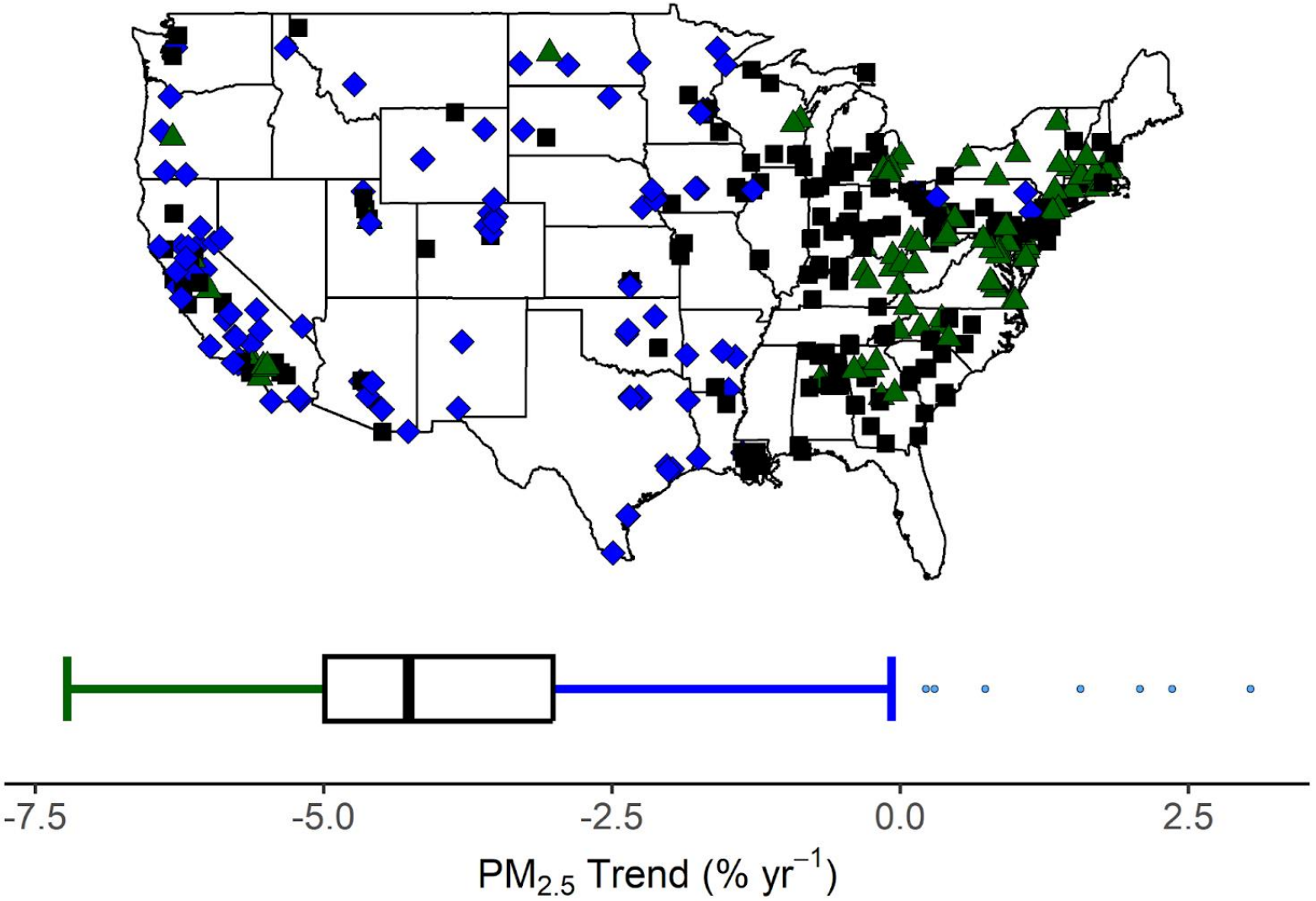
Europe largely employed **traditional performance standards** and saw **larger reductions more quickly**

Performance Standards & Air Shed Approaches



https://www.epa.gov/air-trends/particulate-matter-pm25-trends

$PM_{2.5}$ 2002-2017

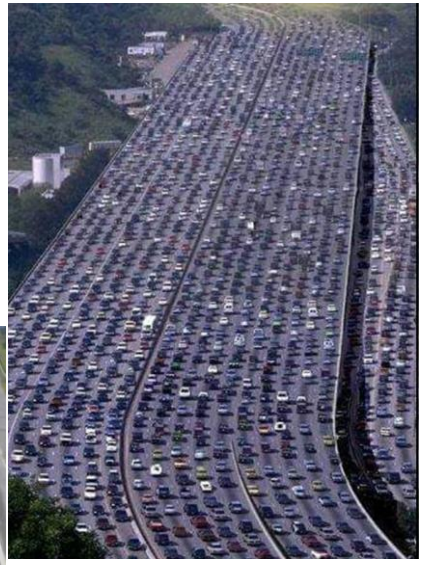


EPA air pollution policy: tremendous success reducing emissions from point sources and motor vehicles

The land sector is traditionally more difficult for EPA

Regulatory $PM_{2.5}$ monitors: accurately describe atmospheric burden?

Most $PM_{2.5}$ forms in atmosphere

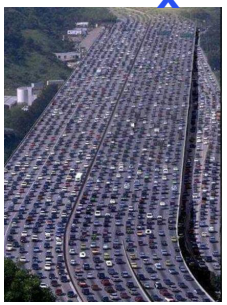


Sulfate
Nitrate
Organic carbon
Black carbon

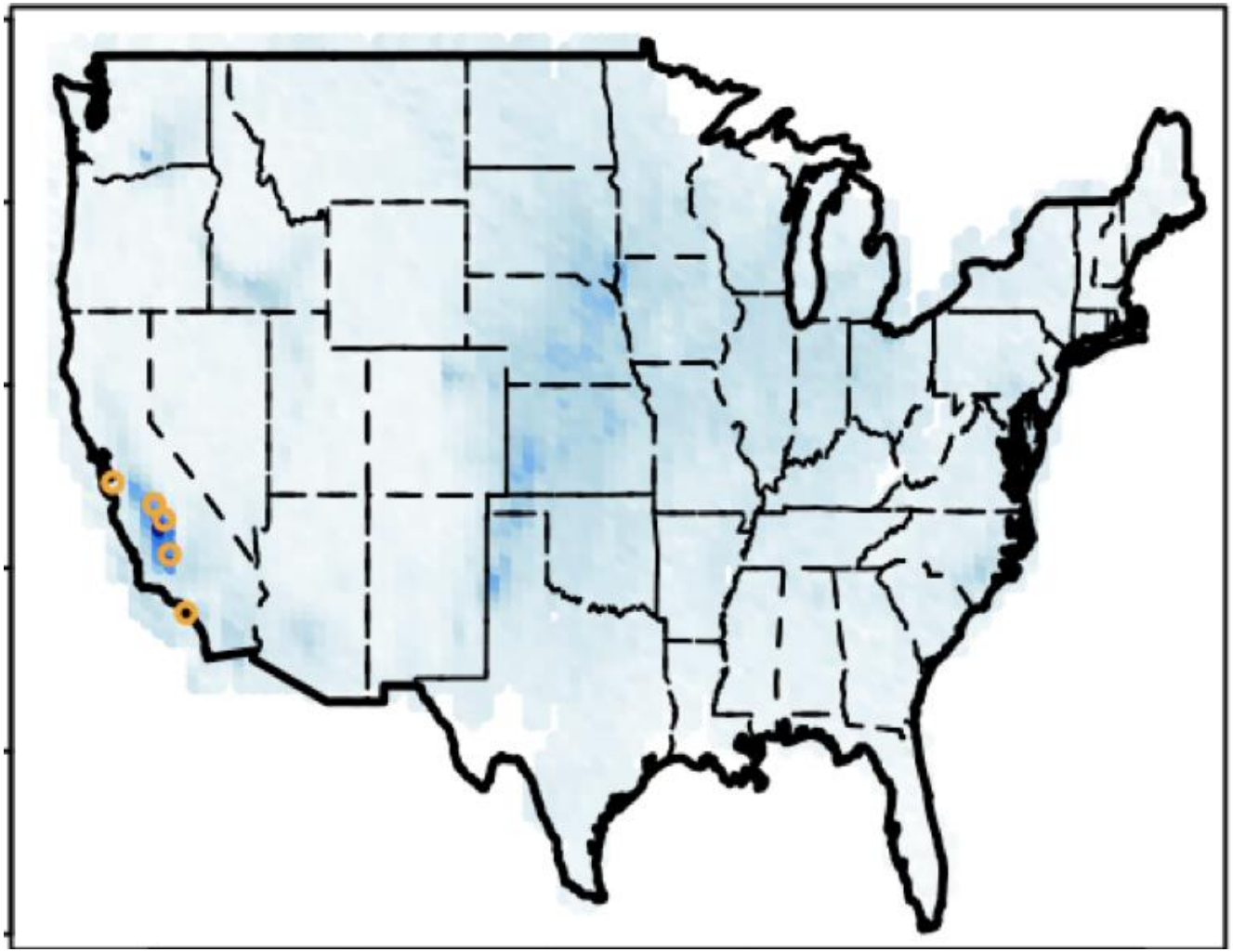
$PM_{2.5}$ is salty

chemistry

NH_3 + SO_2 → $(NH_4)_2SO_4$

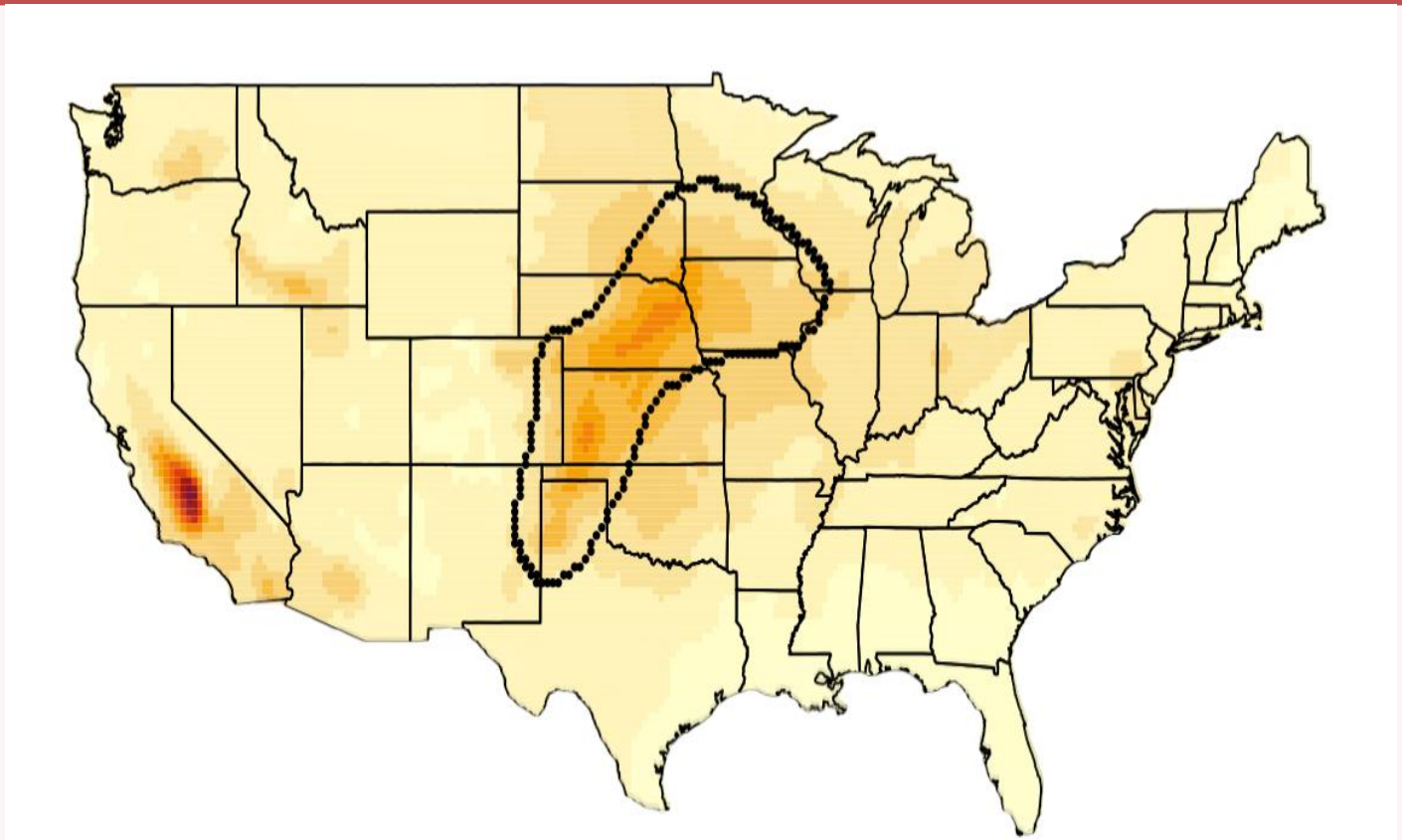
NH_3 + NO_x  → $(NH_4)NO_3$

NH_3 & Most Polluted Cities

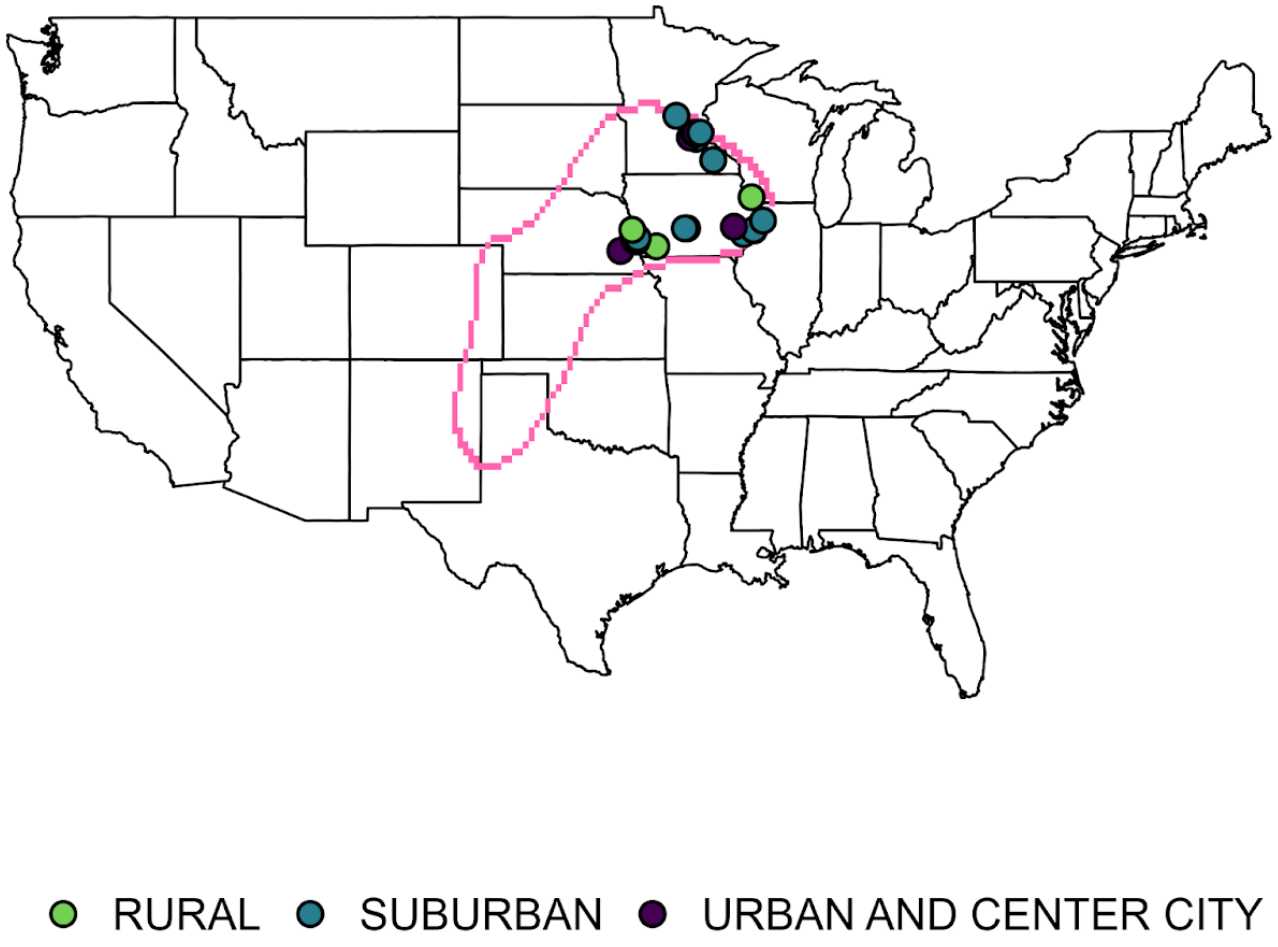


- most polluted cities for year-round $PM_{2.5}$

Change in ammonia from 2002-2017



Independent patterns for animals & ammonia are remarkably similar


RURAL
SUBURBAN
URBAN AND CENTER CITY

Air pollution from agriculture

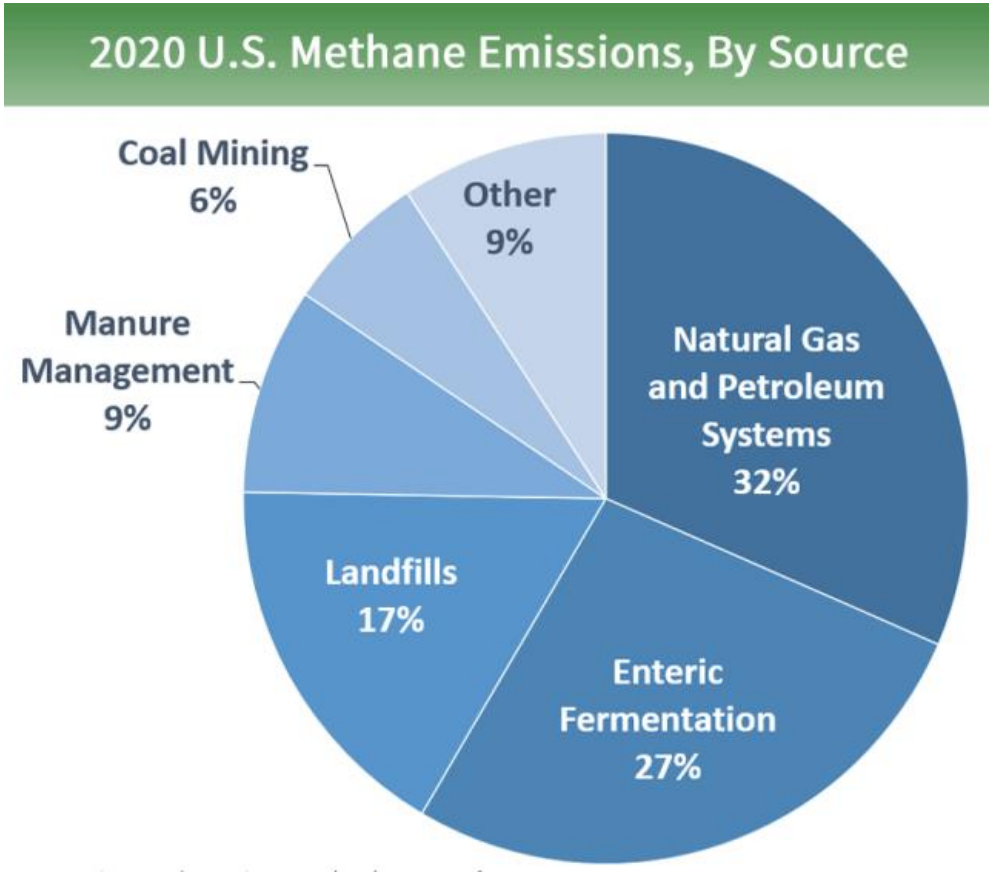
Agriculture is the largest source of several air pollutants that degrade air quality & contribute to the climate crisis

Ag emissions are poorly quantified & largely unregulated.

THERE IS LITTLE PUBLIC DATA

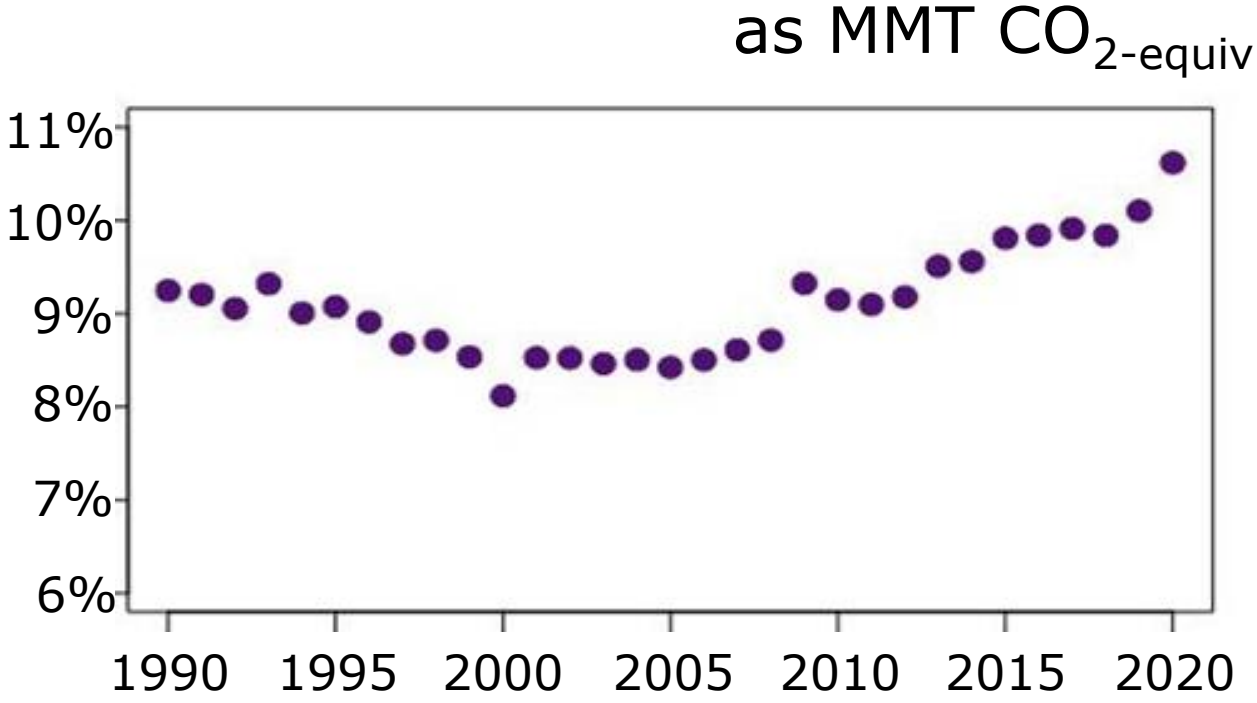
Hurdles are largely social & political, not scientific & technological

Ag is largest source of methane



Source: EPA

Fraction of US GHG emissions from AG



Source: EPA

Summary

The emissions that adversely impact air quality also affect climate. Air Quality is vastly improved. What are the lessons learned?

Rural air quality is not as routinely measured relative to urban population centers. To what extent does this hinder accurate quantitative understanding of current conditions and trends?

21st century science and technology makes it harder for pollution to hide. What role should new tech play in regulatory policy?

Acknowledgements

CONCAWE organizers

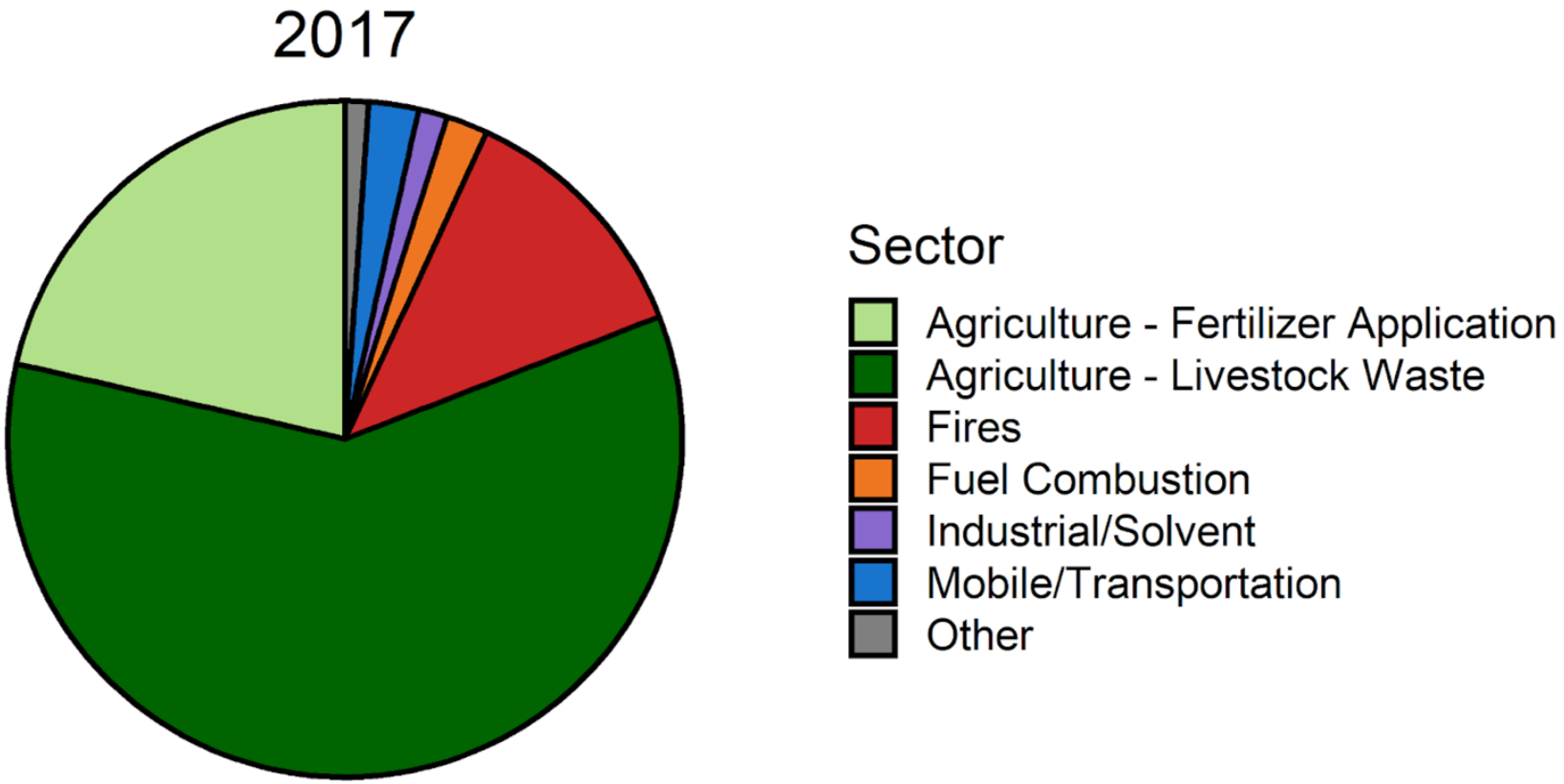
Federal level funding for sciences safeguards human health and environment: NSF, NASA, NOAA, EPA, DoD, WHOSTP

At federal, state and local levels: technicians, program managers, data managers, etc.

Alyssa Burns, Gabe Chandler, Kira Dunham

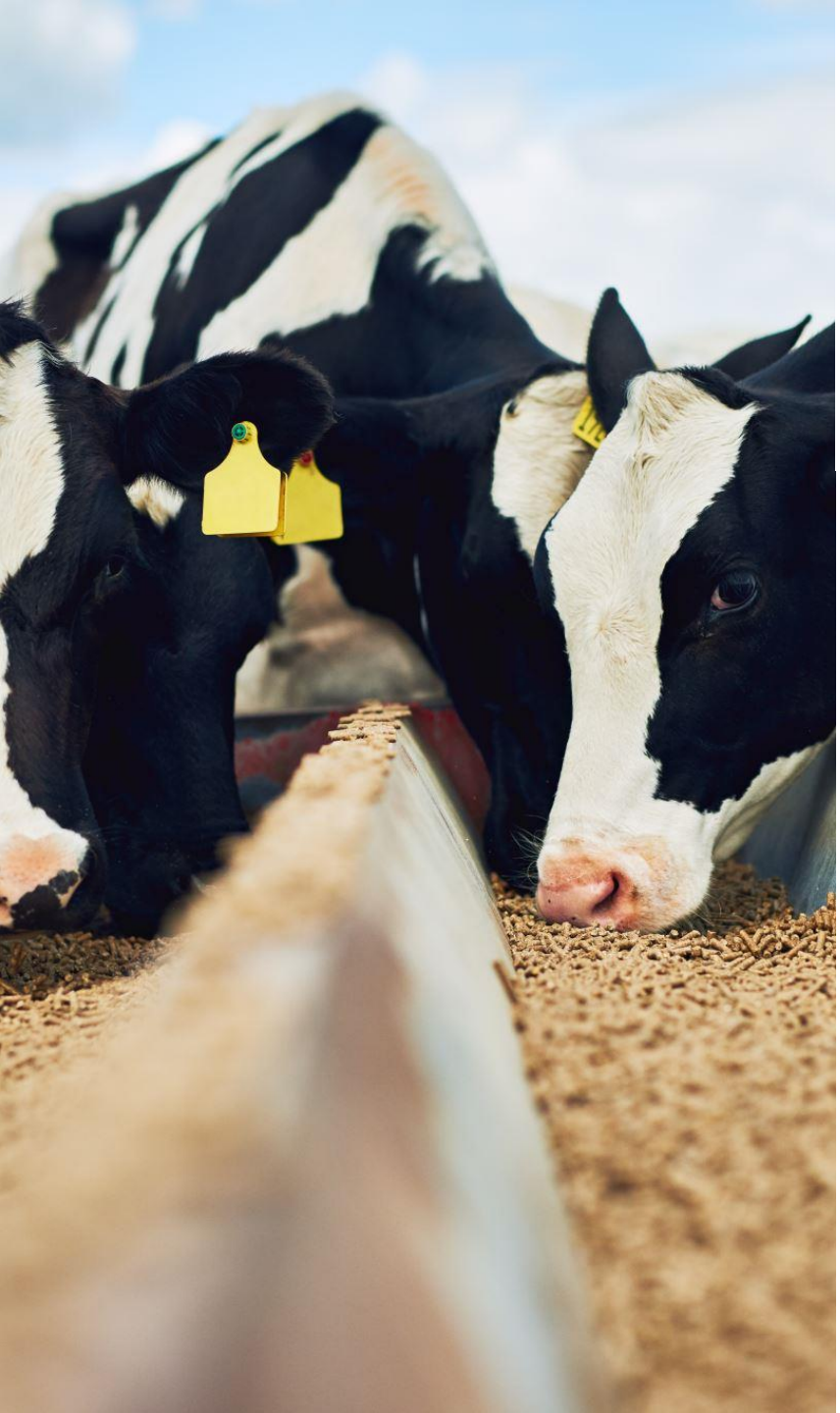
EXTRA SLIDES

U.S. ammonia sources



EPA's National Emissions Inventory: NH_3 from livestock 3x all other sources combined, including fertilizer

*estimated from activity data and feed look up tables



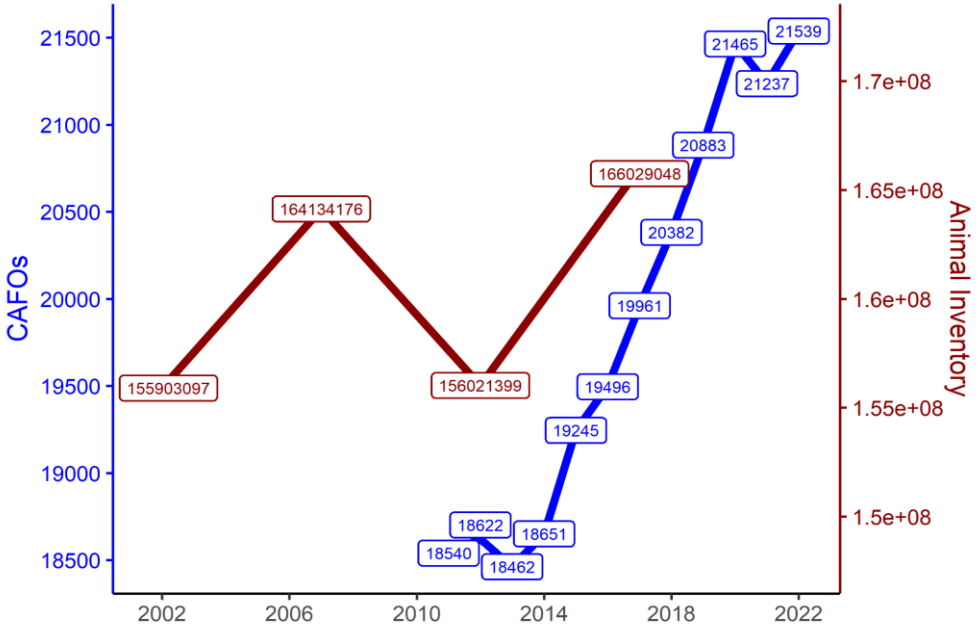
animal unit density at CAFOs

USDA Census of Agriculture: available every 5 years from 1997-2017, **largest CAFOs missing**

Under EPA's NPDES program, some states report raw numbers of CAFOs

Both data sets are incomplete

animal unit numbers not increasing, animal density is increasing



policy & regulations for agriculture

EPA regulates NH_3 under CERCLA & EPCRA *except* when on farm

2006: EPA "Final Order" CAFO that paid a nominal penalty to fund a 2-year study to establish Emissions Estimating Methodologies (EEMs) protected from penalty

EEMs not finalized & Order still in effect; IG urged EPA to end the Order

2008: GAO urged better data for EPA to regulate CAFOs

NEPA exempts agriculture and CAFOs from some requirements, also Agency categorical exemptions. **2018**: FARM Act exempts farms from any self-reporting requirements for animal waste

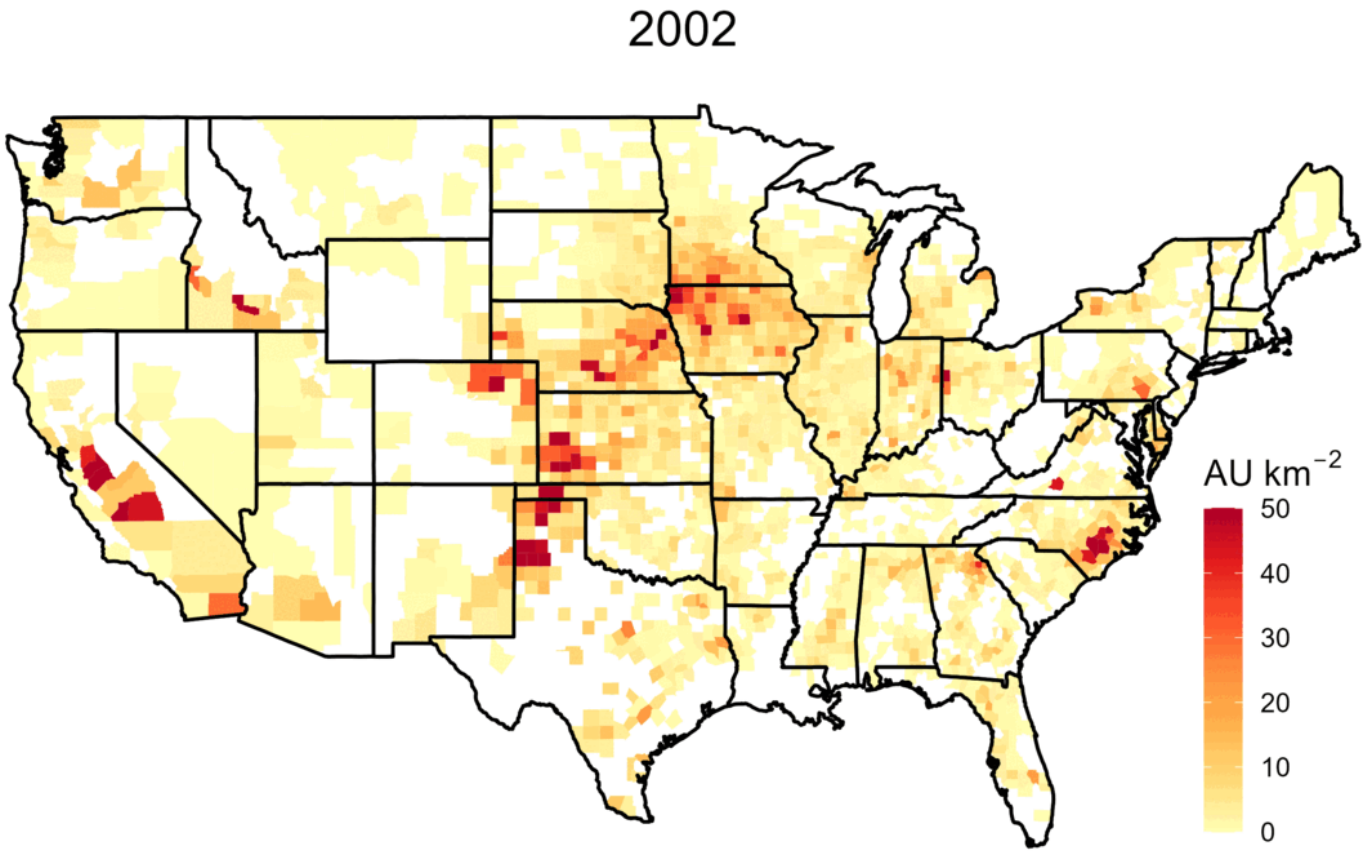
2021, 2022, … riders in Appropriations Act prohibit use of funds to issue air permits or require GHG reporting from animal manure management

farm workers during Covid **&** epic wildfire

The most ambitious climate plans to decarbonize ‘everything’ will improve AQ in cities. What about agricultural regions?

Migrant, seasonal workers are among the most vulnerable in the US & globally

animal units



animal unit is roughly 1000lb of live weight: individual cattle or cow, 2.5 hogs, and 125 chickens.