

# Air and Energy Research & Collaborations

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Department of Defense Environmental Monitoring &  
Data Quality Workshop – Orlando, FL

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U.S. Environmental Protection Agency, Office of Research & Development  
National Risk Management Research Laboratory, Air and Energy Management Division



# GENERAL OVERVIEW

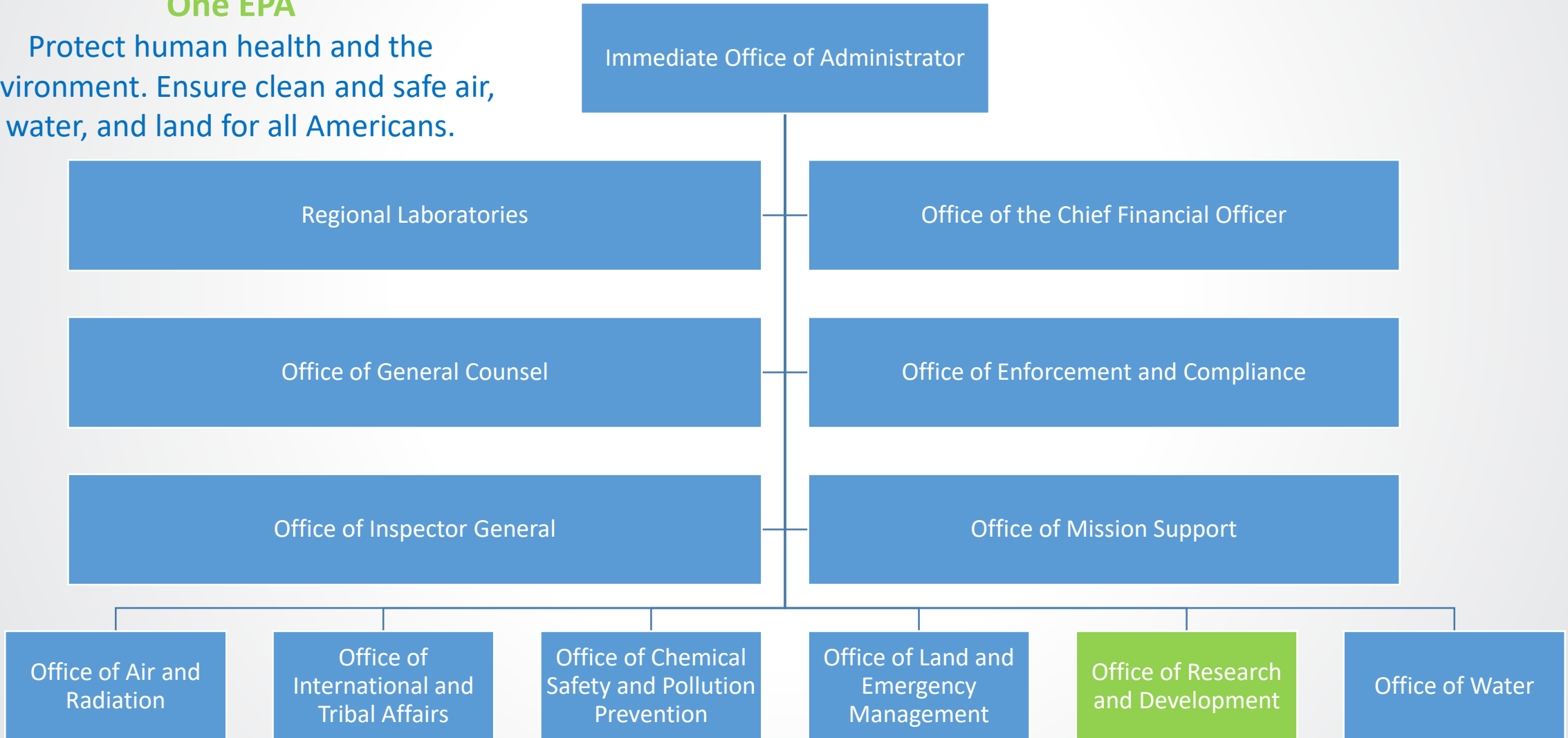
- Structure, Mission, and Vision
  - US Environmental Protection Agency (EPA), Office of Research and Development (ORD)
  - National Risk Management Research Laboratory (NRMRL), Air and Energy Management Division
- Topics of Interest
  - Research Collaborations
  - Next Generation Emissions Measurements (NGEM)
  - Kansas City Transportation and Local-Scale Air Quality Study (KC-TRAQS)
  - Emission Measurement Tools
  - Emission Characterization Tools
  - Emerging Areas
- Summary
- Questions



# EPA ORGANIZATIONAL CHART

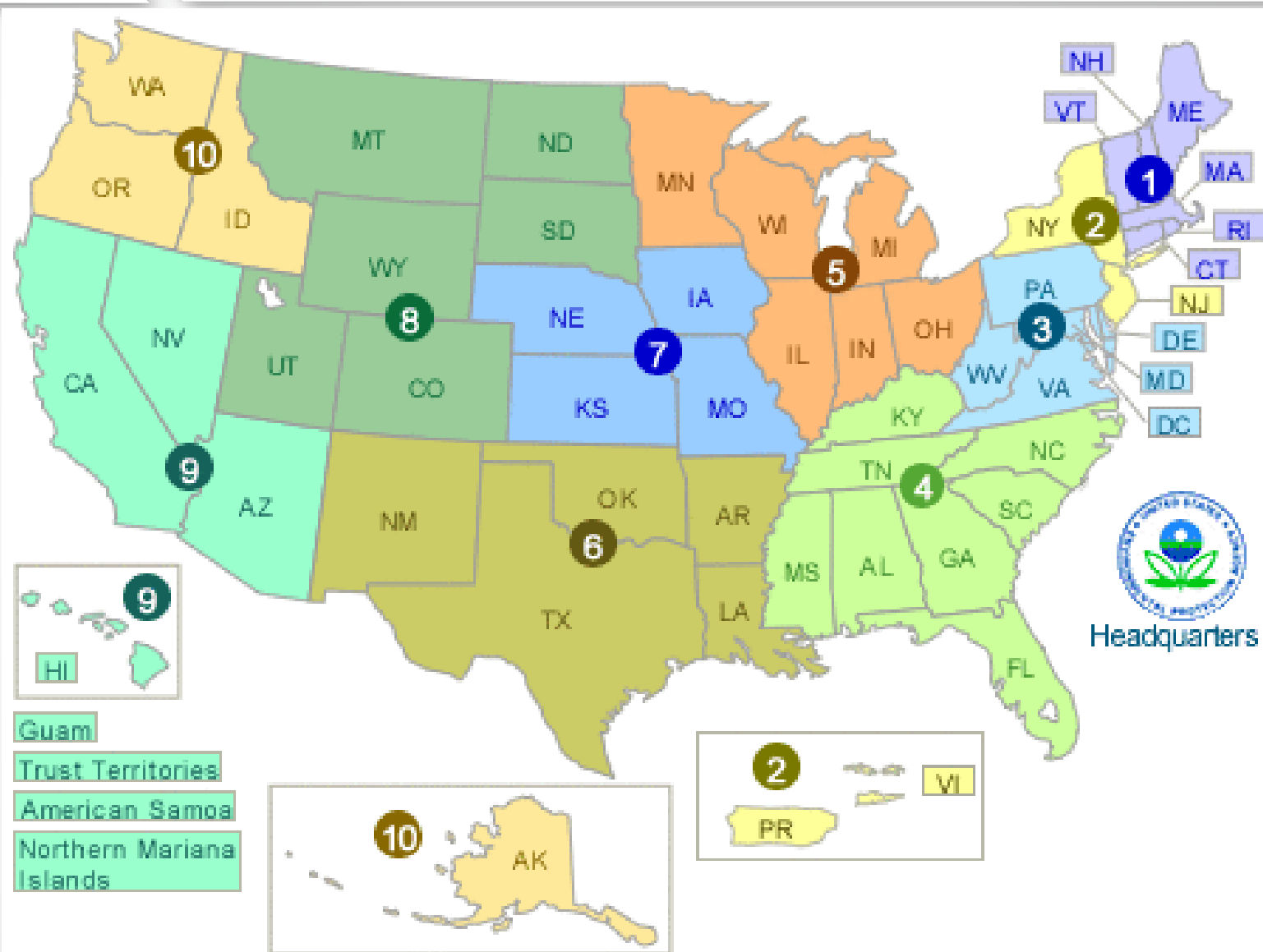
## One EPA

Protect human health and the environment. Ensure clean and safe air, water, and land for all Americans.



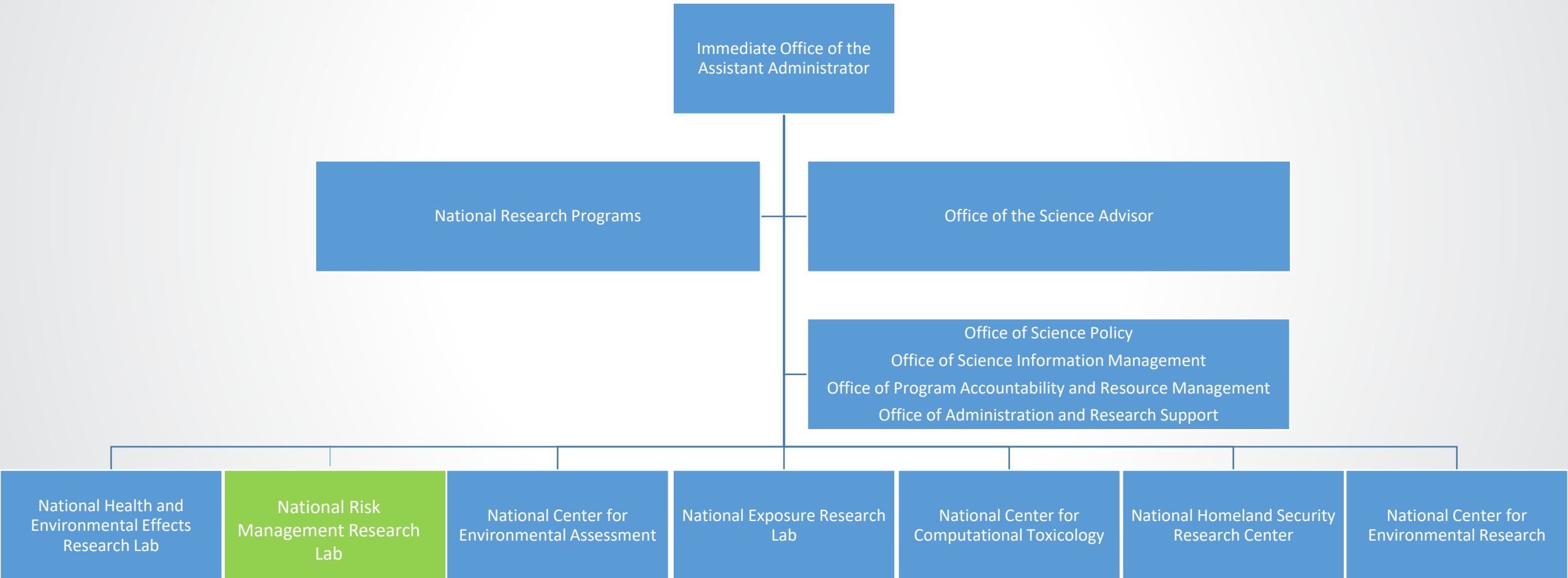


# REGIONAL LABORATORIES





# ORD ORGANIZATIONAL CHART

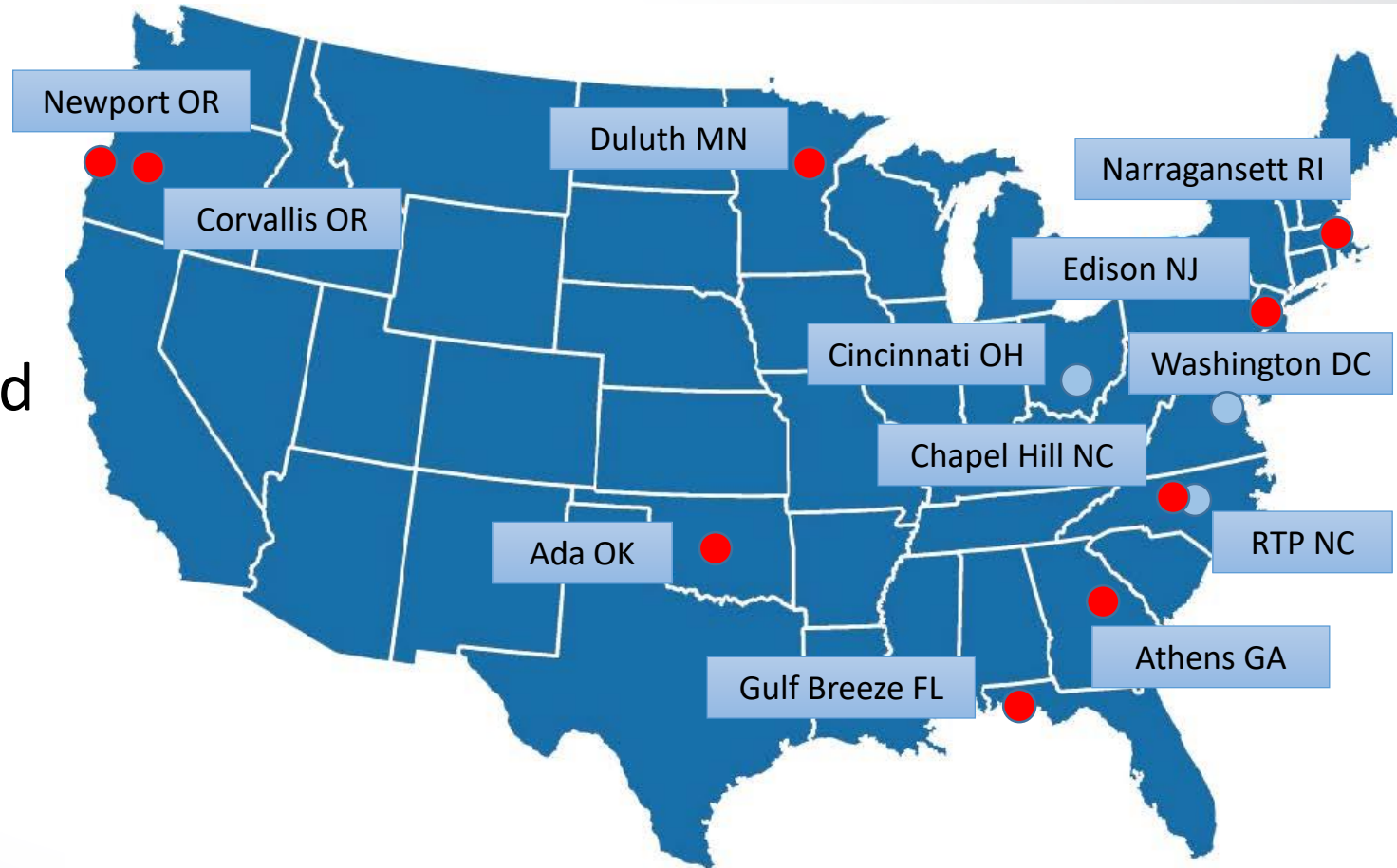






# ORD MISSION

Provide the science and technology, technical support, and tools to inform EPA's mission to protect public health and the environment.





# NATIONAL RESEARCH PROGRAMS

## Air & Energy

- Interplay between air pollution, climate change, and energy
- Solutions to improve air quality



## Sustainable & Healthy Communities

- Ecosystem services
- Human health
- Contaminated site remediation and restoration



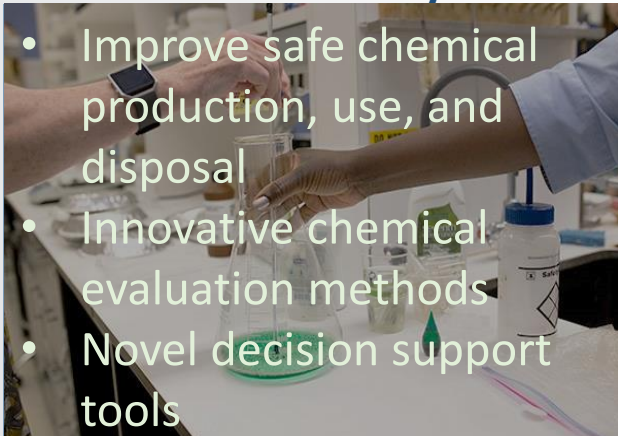
## Homeland Security

- Water system security
- Resilience and remediating wide areas



## Chemical Safety for Sustainability

- Improve safe chemical production, use, and disposal
- Innovative chemical evaluation methods
- Novel decision support tools



## Human Health Risk Assessment

- Risk assessments for specific chemicals
- Risk assessment methods



## Safe & Sustainable Water Resources

- Drinking water treatment systems
- Surface water quality







# NATIONAL RISK MANAGEMENT RESEARCH LABORATORY (NRMRL)

NRMRL

Air and Energy  
Management  
(RTP, NC)

Land and Materials  
Management  
(Cincinnati, OH)

Water Systems  
(Cincinnati, OH)

Groundwater,  
Watershed, and  
Ecosystem Restoration  
(Ada, OK)







# AIR AND ENERGY MANAGEMENT DIVISION

## Perform

Perform advanced method development for air pollutant sampling, characterization, and analysis.

## Provide

Provide solution-oriented mitigation of air pollutant sources.

## Develop

Develop robust decision-making tools to minimize environmental impact of industrial sources.

## Assess

Assess environmental implications of energy system choices.

## Accomplish

Accomplish our mission through diverse stakeholder partnerships from industry collaborators, to government agencies, to everyday citizens.



# RESEARCH AND SOLUTIONS

## RESEARCH

- Landscape of science is constantly evolving
- Pollutants measured at previously unseen levels of detection
- Novel, innovative technology unveiled at a rapid pace
- Emerging environmental issues and contaminants of concern

## SOLUTIONS

- Development and application of innovative approaches
- Improvement in problem solving capacity
- Formation of successful alliances with stakeholders





# TOPICS OF INTEREST

## Call for Abstracts

Emerging Contaminants	Air Monitoring
Per-and Polyfluoroalkyl Substances (PFAS)	Vapor Intrusion
Method Innovation	SERDP/ESTCP
Data Quality and Forensic Determination	Sampling
Device Validation and Usability	Data Management





# SOME RESEARCH COLLABORATIONS

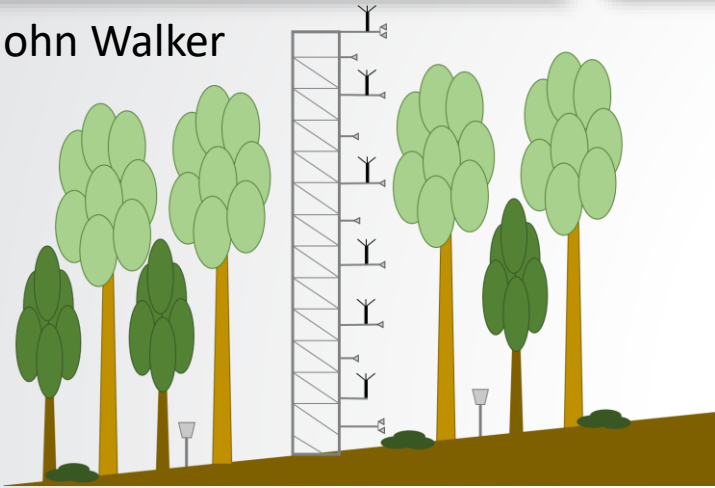
- Atmosphere-Biosphere Exchange – Nitrogen and Ammonia
- Global Change Assessment Model (GCAM) with GLIMPSE Interface
- Mobile Measurements to Update On-road Transportation Emissions
- Green Infrastructure Impact on Air Pollution and Health
- Leaching Environmental Assessment Framework (LEAF)
- VOC Emission Tracker (VET) Detecting Fugitive Air Toxic Emissions Household Energy Research
- Particulate Matter from Cookstove Source Emissions
- And so much more.....





# ATMOSPHERE-BIOSPHERE EXCHANGE

John Walker

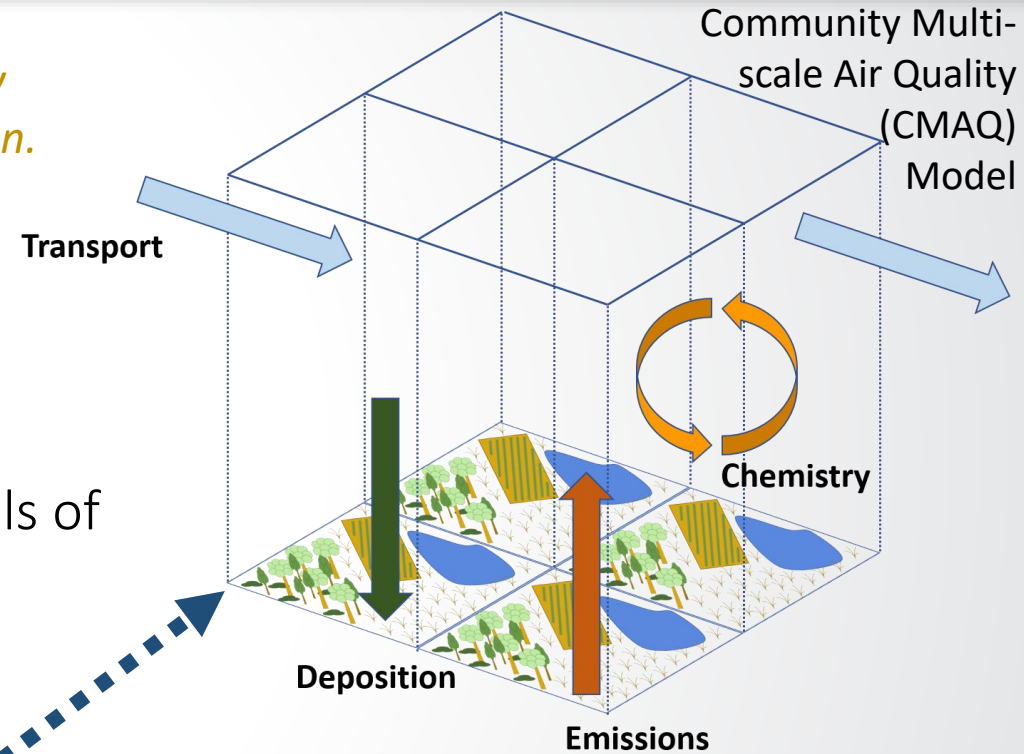


Measurements of air-surface exchange

- Emissions from soils and vegetation
- Dry deposition of gases and particles
- Bidirectional exchange

*Collaboration has recently focused on reactive Nitrogen.*

Improved field-scale models of air-surface exchange



More accurate representation of biogenic emissions and atmospheric deposition in chemical transport models

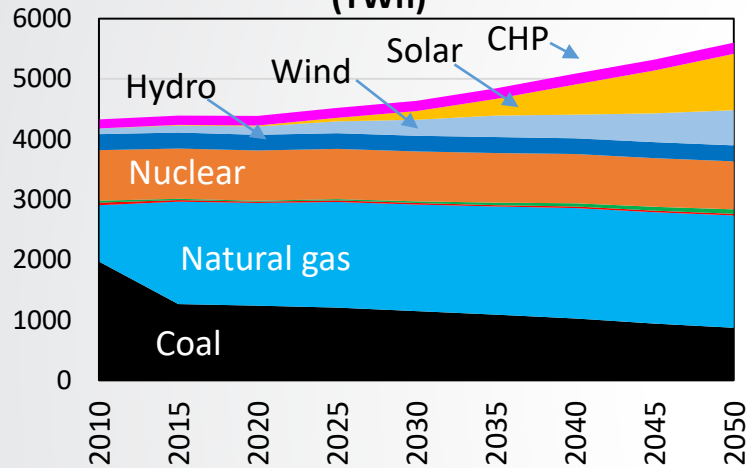


*Illustrative results*

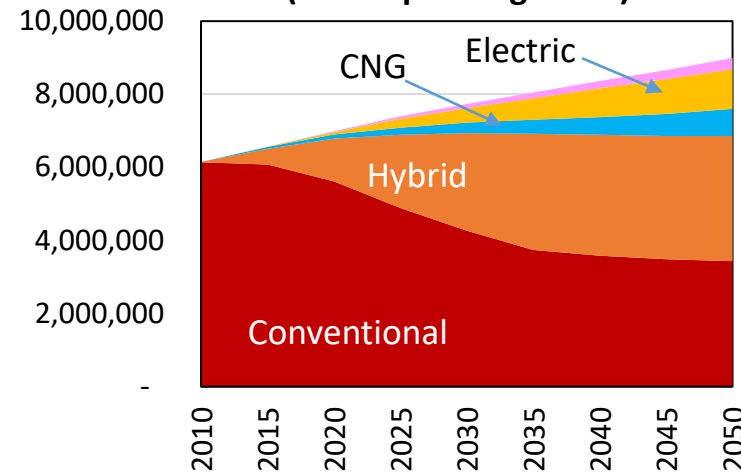
# GLIMPSE PROJECT & GCAM-USA OUTPUTS

Global Change Assessment Model (GCAM)

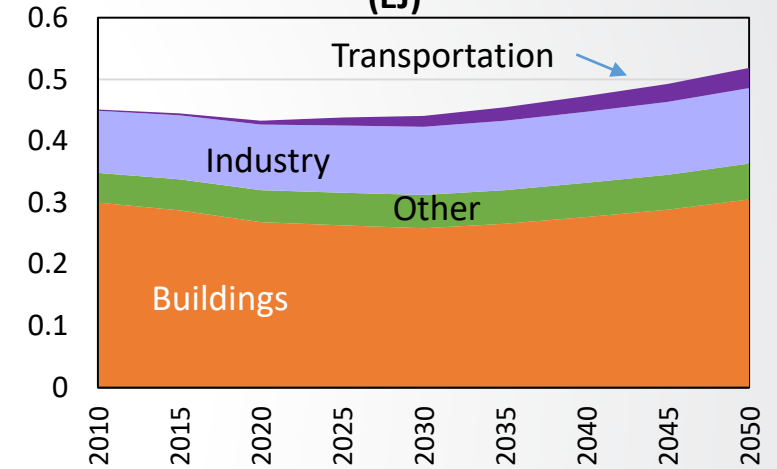
Electricity production by category  
(TWh)



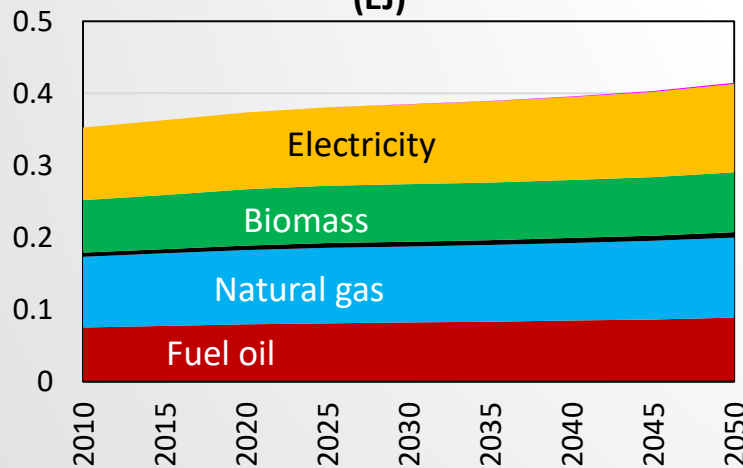
Light duty travel by technology  
(billion passenger-km)



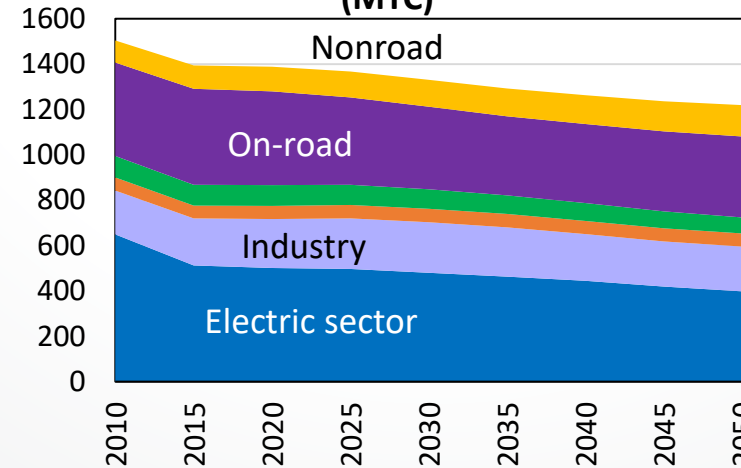
Electricity Use By Sector  
(EJ)



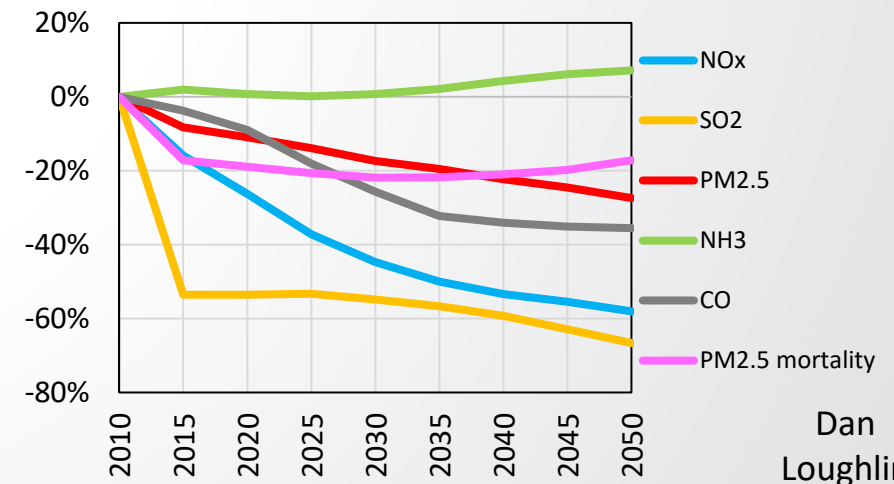
Industrial energy use by fuel  
(EJ)



CO2 emissions by sector  
(MTC)



Change relative to 2010







# NEXT GENERATION EMISSIONS MEASUREMENTS (NGEM)



Personal Sensors

Ambient and  
Indoor Sensors

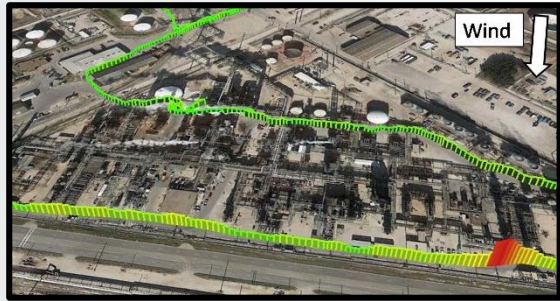


Eben Thoma

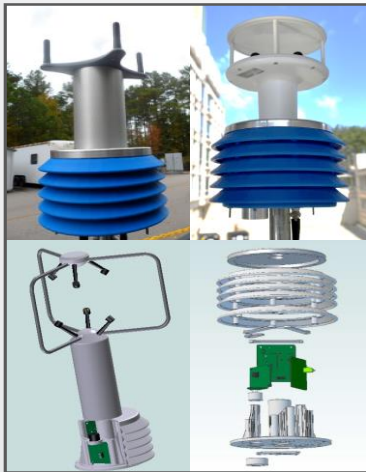
Sensors for  
Industry / Energy  
/ Near Source  
Impacts



# NGEM – PRESENT AND FUTURE



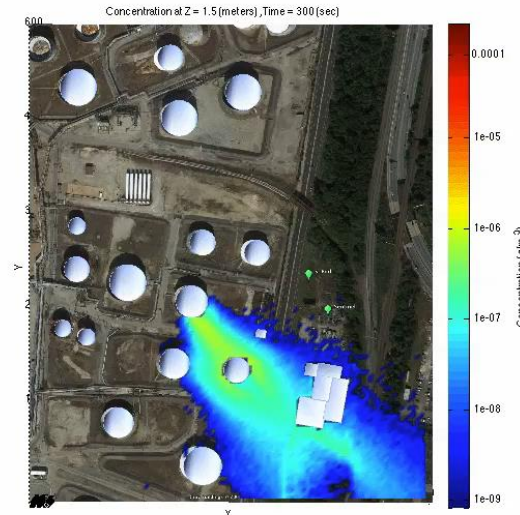
Metrology



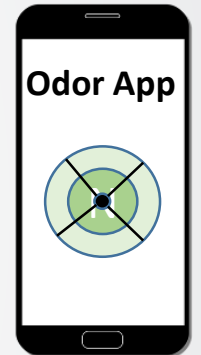
Facility Sensors



Personal and  
Community Sensors



Informetrics



Rachelle  
Duvall

Metadata



Geospatial

- New approaches for difficult sources
- Sensors in facilities and in communities
- Crowdsourcing odor and other observations
- Hybrid measurement/model systems
- Predictive and transparent informetric



# KC-TRAQS FIELD CAMPAIGN

- Kansas City Transportation and Local-scale Air Quality Study (KC-TRAQS) – 53 devices; Millions of data points requiring extensive data management, validation, and analysis
- Exemplary project designed, developed, and demonstrated through the leveraging of tools and resources
  - Participants – Office of Research and Development, Region 7, and Office of Transportation and Air Quality
  - Measurements – Fixed and mobile
    - Village Green Bench data and fixed monitors (particulate matter [PM<sub>2.5</sub>], black carbon [BC])
    - Geospatial Mapping of Air Pollution (GMAP)
  - Citizen Science – AirMapper
  - Modeling Tools – Modified C-Port



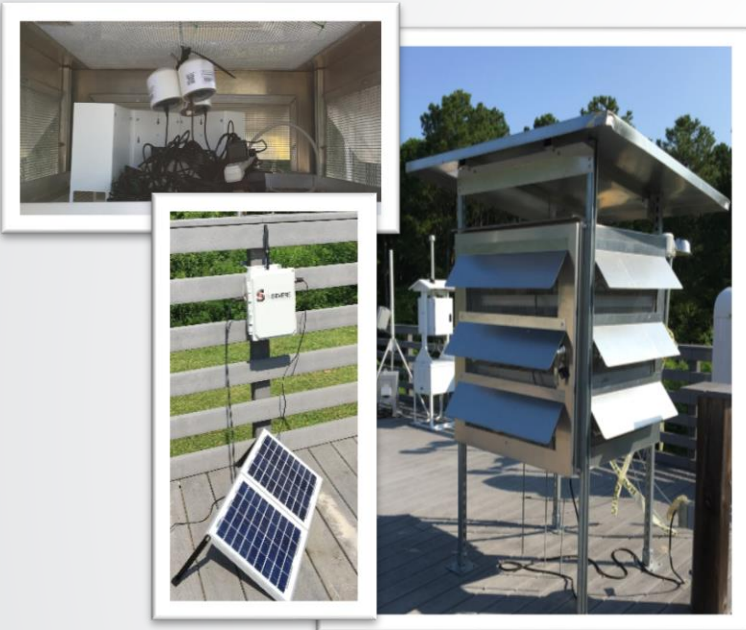
Sue  
Kimbrough







# ORD EMISSION MEASUREMENT TOOLS



Amara Holder

Low-cost  
PM  
Sensors



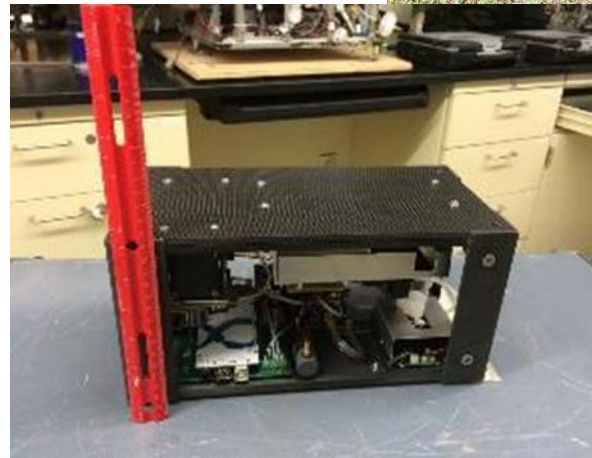
Jeff Ryan



Method Modifications



USGS Unmanned  
Aerial  
System (UAS)  
with ORD  
“Kolibri”  
Sensor/Sampler



Brian Gullett







# ORD EMISSION CHARACTERIZATION TOOLS

- Laboratory and pilot-scale source emissions characterization
  - Stationary diesel genset
  - Multi-Pollutant Control Research Facility (MPCRF)
  - EtO sterilizer
- Field studies
  - Rural and urban settings
  - Near-source
  - Fugitive emissions



**AEMD's Stationary  
Diesel Facility  
(200kW genset)**



**NHSRC's Laboratory  
EtO sterilizer**

Tiffany Yelverton

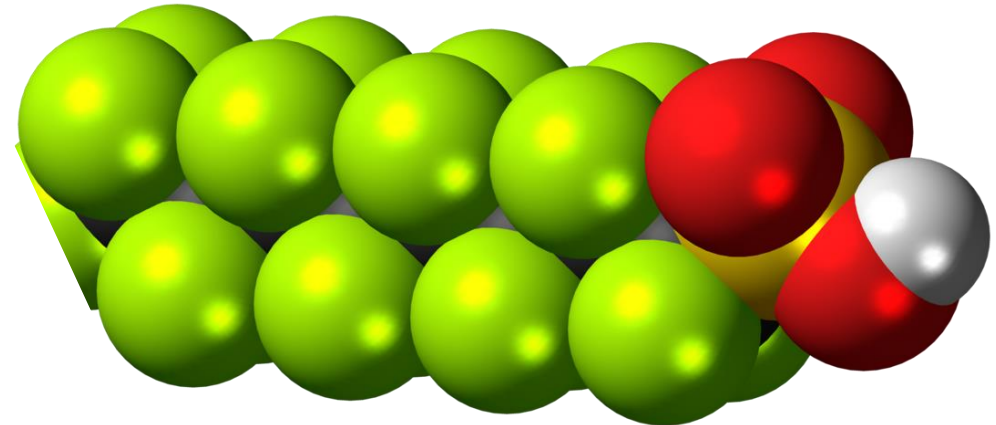


**AEMD's Multi-Pollutant Control  
Research Facility (MPCRF)**

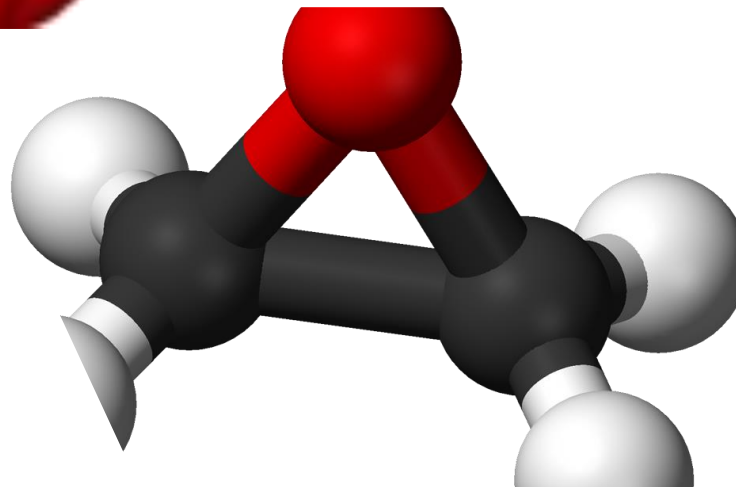
Per-fluorinated



Poly-fluorinated



Ethylene Oxide







# PFAS AIR EMISSIONS

- Methods Development Research
  - Accepted source and ambient air method(s) for PFAS do not exist
  - Emissions measurement methods are needed for multiple purposes (source characterization, control technology evaluation) with industrial emission sources, including incineration sources, extremely diverse
  - Methods needed to inform policy/regulatory decisions for non/semi-volatiles, volatiles, and performance-based methods to assess measurement performance and data quality
- Comprehensive Analyte List
  - Compounds needing to be targeted is a challenge, since emission tests often target only a small number of PFAS compounds for analysis while significantly more may be present
- Collaboration/Partnership Integral
  - Response to state/region/programmatic needs necessary
  - Resources (equipment, dollars, FTEs)

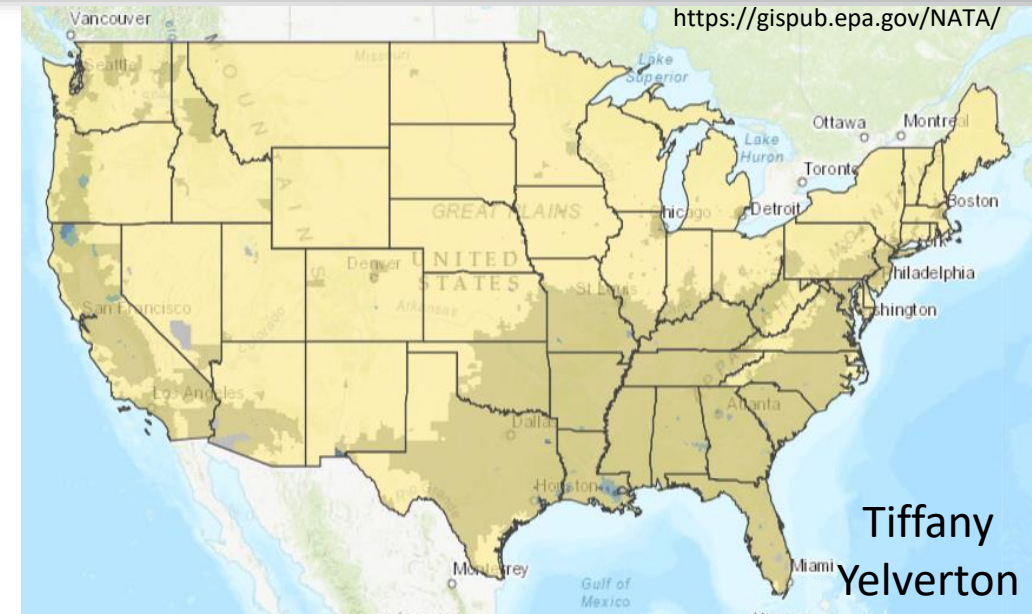
Jeff Ryan





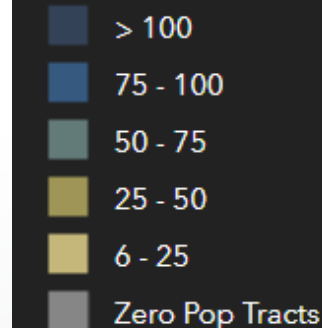
# ETHYLENE OXIDE (EtO) EMISSIONS

- Integrated Risk Information System (IRIS) assessment – carcinogenic to humans, Unit Risk Estimate (URE) is  $20 \text{ ng/m}^3$  (~10ppt)
- Roughly 30 emitting facilities nationwide with cancer risk greater than 100-in-a-million
  - Production of solvents, antifreeze (ethylene glycol), textiles, detergents, adhesives, polyurethane foam, and pharmaceuticals
  - Low-temperature sterilization processing for food, medical equipment/supplies, and other sensitive materials
- Formation occurs from oxidizing ethylene in the presence of a silver catalyst



## 2014 NATA Risks, Hazard Indices, and Ambient Concentrations

### Cancer Risk - Total Risk





# SUMMARY

- With the ability to measure our environment at previously unseen levels of detection, the landscape of science is constantly evolving
- Emerging environmental issues and contaminants of concern are being investigated to answer the immediate questions of uncertainty with regards to public health and exposure
- Novel, innovative technology is being unveiled at a rapid pace and evaluated for relevance in measurement and monitoring priority areas
- The development or application of an innovative approach; improvement in problem solving capacity; and formation of successful alliances with stakeholders are strategic means for advancing our knowledge to the rapidly changing surroundings



# QUESTIONS

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