# Air and Energy (A-E)
National Research Program

Presentation for AAPCA 2019 Fall Business Meeting

August 27, 2019

Current A-E Broad Program Direction Continues

- Focusing on nexus between air quality, energy, and changing environment

- Maintaining high priority research for EPA Regional and Program Office Partners, States/tribes/local governments, and other key stakeholders

- Broadening public health perspective and context

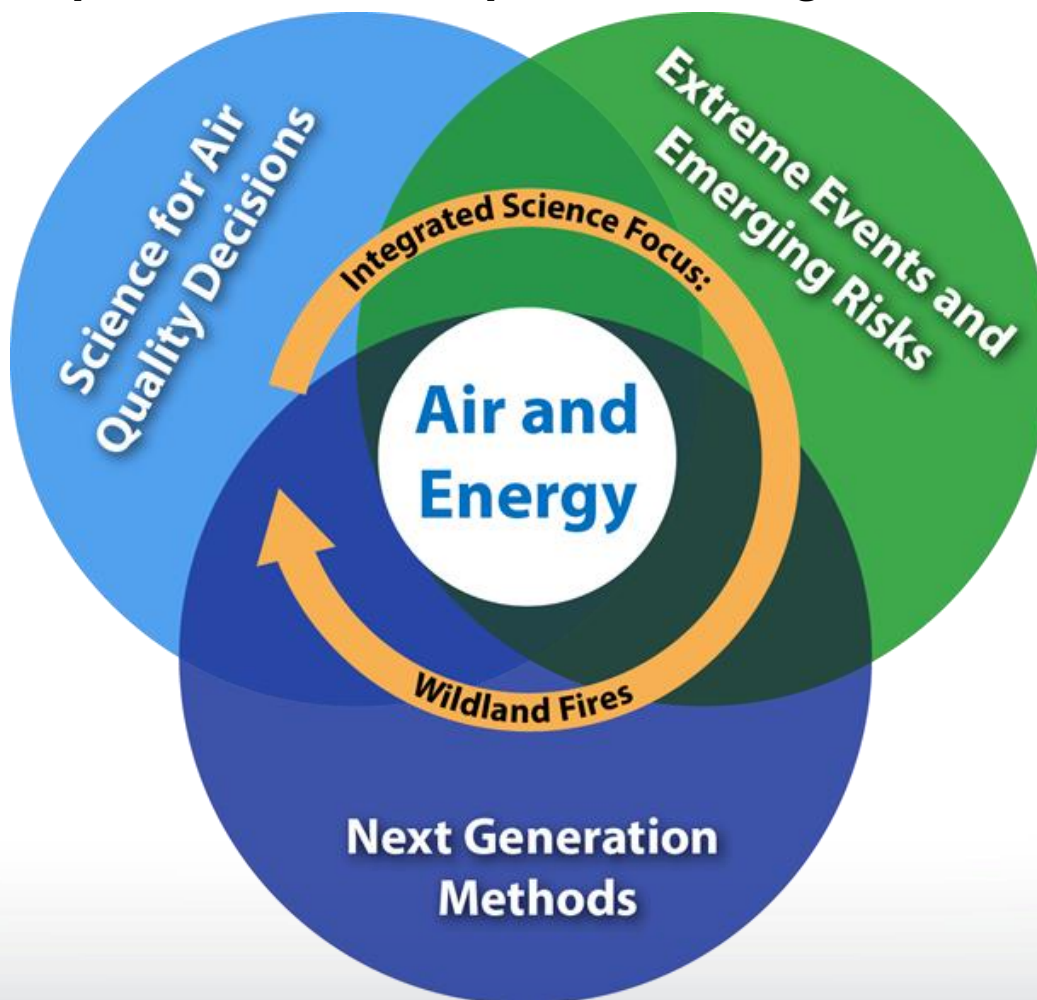- Increasing focus on national issues, e.g., Wildland Fires
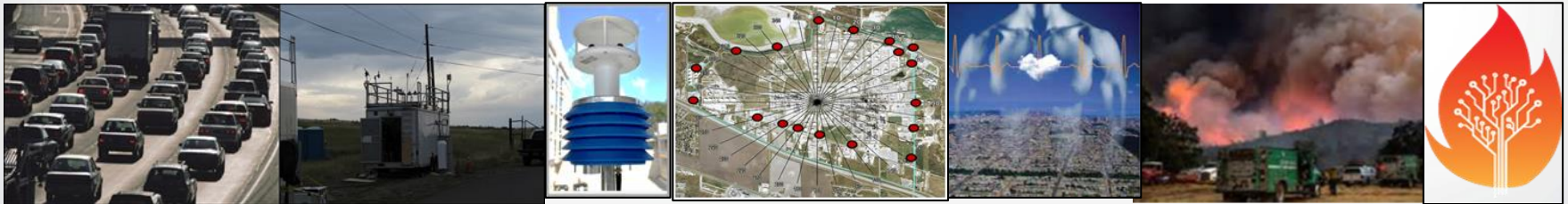
1. **Assess Impacts**

2. **Expand Approaches to Prevent and Reduce Emissions**

3. **Advance Measurement and Modeling**

4. **Inform Decisions**
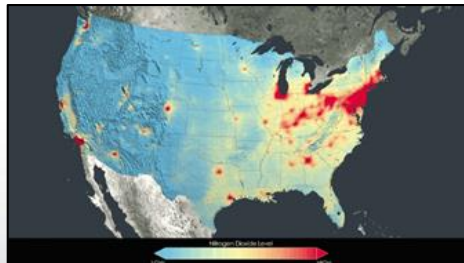
Program Structure

EPA

Research topics/areas are interconnected and rely on multiple scientific disciplines working collaboratively
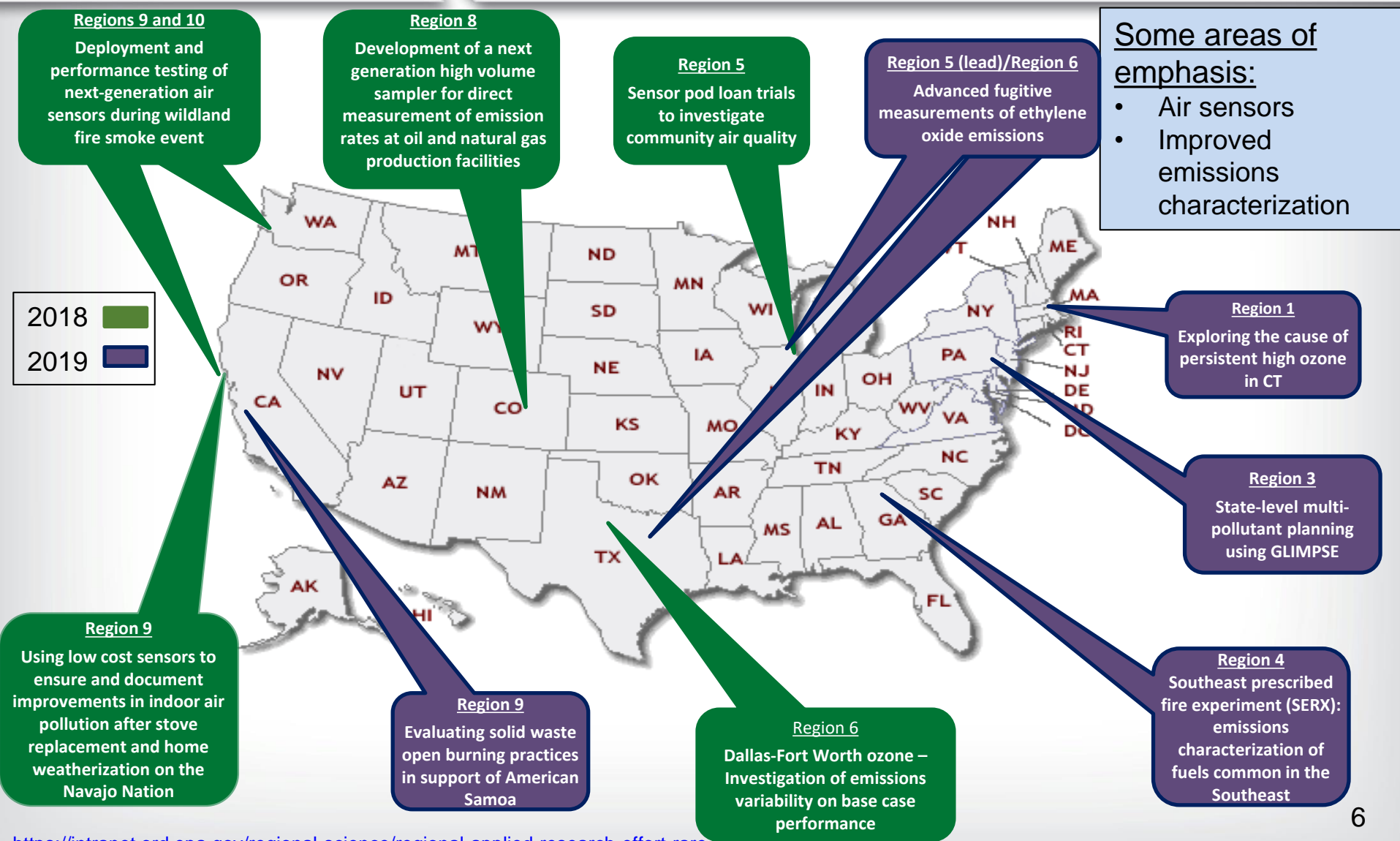
Topics and Research Areas

Topic	Research Areas	
Science for Air Quality Decisions	#1: Approaches to support air quality management programs for multiple pollutants at multiple scales	#9: Wildland Fires (Integrated Science Focus)
	#2: Approaches for characterizing source emissions, air quality, exposure, and mitigation strategies	
	#3 Public health and environmental responses to air pollution	
Extreme Events and Emerging Risks	#4: Public health and ecosystem exposures and responses to emerging air pollutants and sources	
	#5: Methods to evaluate environmental benefits and consequences of changing energy systems	
	#6: Methods to enable resilience to future environmental stressors	
Next Generation Methods to Improve Public Health and the Environment	#7: Emerging approaches to improve air quality and exposure characterization	
	#8: Novel approaches to assess human health and ecosystem impacts and risks	

See Supplemental Information, slides 15-19, for more information on Research Areas

A-E Regional Applied Research Efforts (RARE) Research – FY18/FY19

Regions 9 and 10
Deployment and performance testing of next-generation air sensors during wildland fire smoke event

Region 8
Development of a next generation high volume sampler for direct measurement of emission rates at oil and natural gas production facilities

Region 5
Sensor pod loan trials to investigate community air quality

Region 5 (lead)/Region 6
Advanced fugitive measurements of ethylene oxide emissions

Some areas of emphasis:
- Air sensors
- Improved emissions characterization

Region 1
Exploring the cause of persistent high ozone in CT

Region 3
State-level multi-pollutant planning using GLIMPSE

Region 9
Using low cost sensors to ensure and document improvements in indoor air pollution after stove replacement and home weatherization on the Navajo Nation

Region 9
Evaluating solid waste open burning practices in support of American Samoa

Region 6
Dallas-Fort Worth ozone – Investigation of emissions variability on base case performance

Region 4
Southeast prescribed fire experiment (SERX): emissions characterization of fuels common in the Southeast

2018
2019

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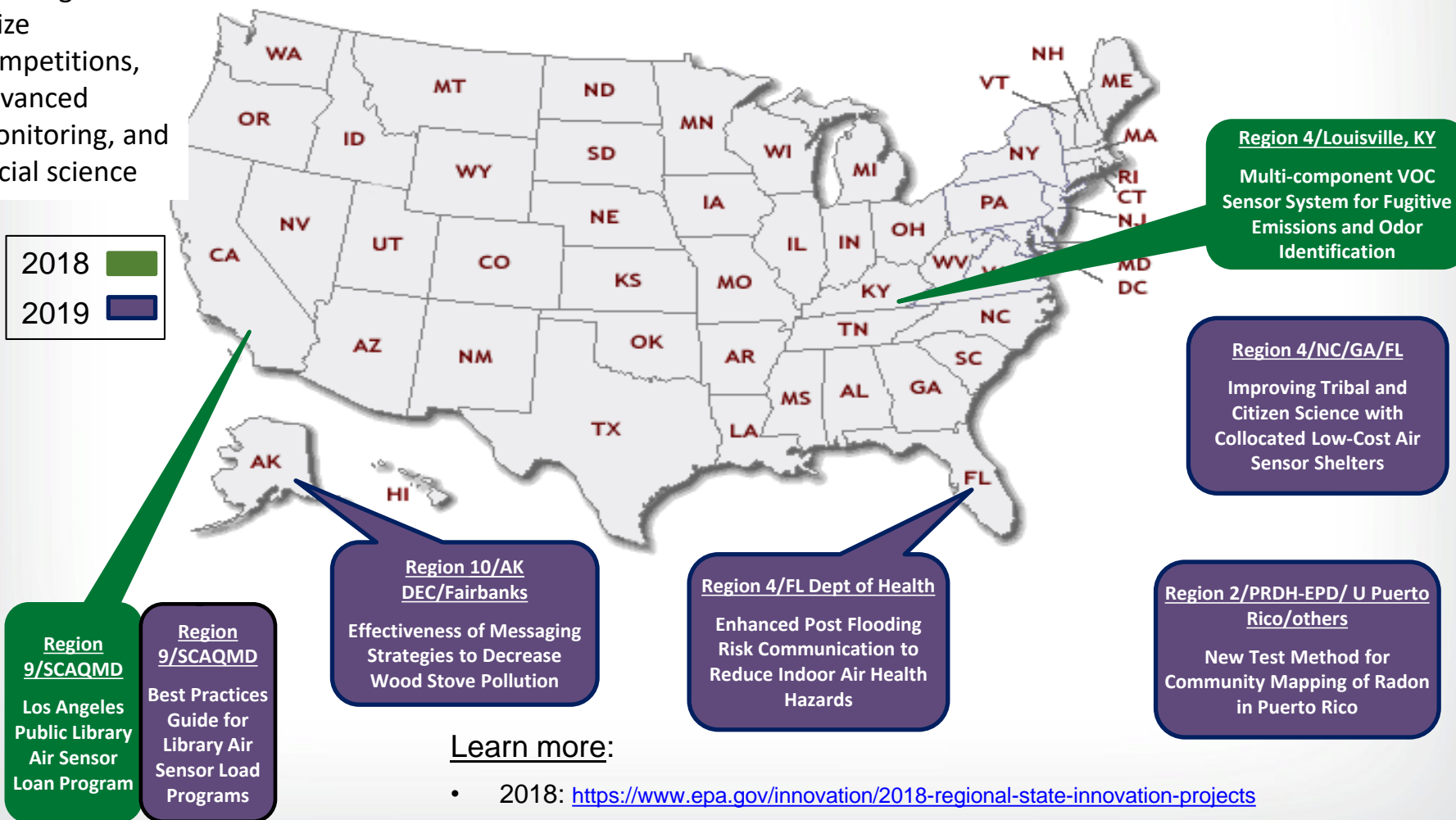https://intranet.ord.epa.gov/regional-science/regional-applied-research-effort-rare

A-E Regional-State-Tribal Innovation Projects 2018/2019

citizen science, challenge and prize competitions, advanced monitoring, and social science

## State and Tribal Partnerships for Environmental Priorities

2018
2019

Region 4/Louisville, KY

Multi-component VOC Sensor System for Fugitive Emissions and Odor Identification

Region 4/NC/GA/FL

Improving Tribal and Citizen Science with Collocated Low-Cost Air Sensor Shelters

Region 9/SCAQMD

Los Angeles Public Library Air Sensor Loan Program

Region 9/SCAQMD

Best Practices Guide for Library Air Sensor Load Programs

Region 10/AK DEC/Fairbanks

Effectiveness of Messaging Strategies to Decrease Wood Stove Pollution

Region 4/FL Dept of Health

Enhanced Post Flooding Risk Communication to Reduce Indoor Air Health Hazards

Region 2/PRDH-EPD/ U Puerto Rico/others

New Test Method for Community Mapping of Radon in Puerto Rico

Learn more:

- 2018: https://www.epa.gov/innovation/2018-regional-state-innovation-projects
- 2019: https://www.epa.gov/innovation/2019-regionalstatetribal-innovation-projects

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- Federal Reference and Equivalent Methods (**FRM/FEMs)**

- Independent evaluation of **low-cost air sensor technologies**

- Field Campaigns **(e.g., DISCOVER-AQ, LMOS, LISTOS)**

- **Village Green Project** – Solar-powered park bench with small, high quality instruments, streams real-time meteorology, O_3, and PM data to public (currently 8 active)
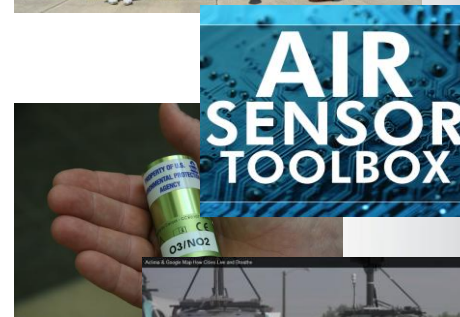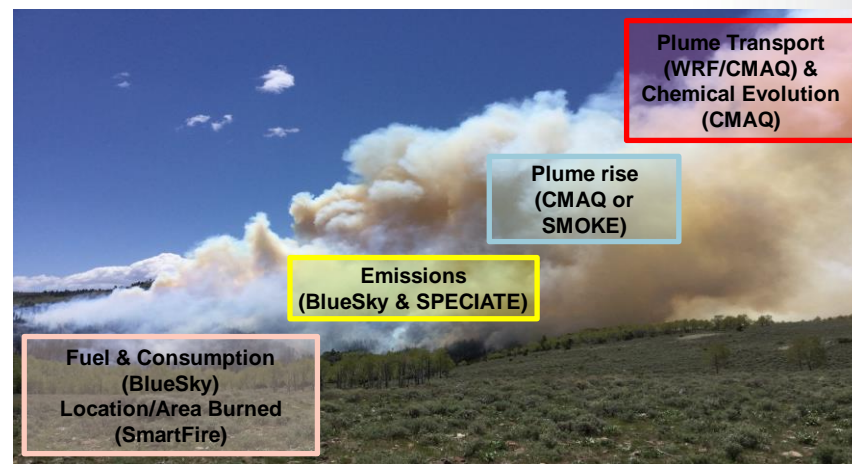
- **Sensor technologies are revolutionizing air monitoring**
  - Great promise and great challenges
- **ORD international leadership - high impact in short time**
  - Lab and field evaluation of technology performance
  - Convene international, broad stakeholder workshops
  - Partnerships with states, EPA regions, and federal agencies
    - Fence-line methods for VOCs
    - Wildland fire sensor challenge
    - Sensor projects in communities
  - Outreach/guidance: Air Sensor Toolbox

- MASIC study comparing FRM/FEM and low-cost sensors link

- Flint Hills, KS prescribed fire emissions measurements using unmanned aircraft system link

- Improved modeling of plumes

- STAR grants studying impacts of climate change on wildfires and air quality link

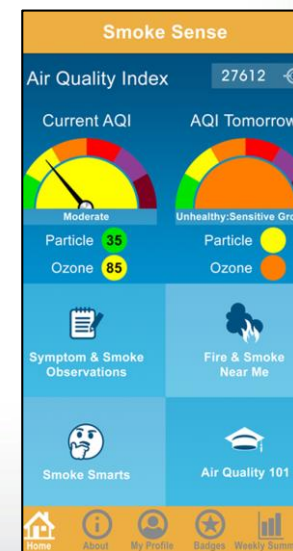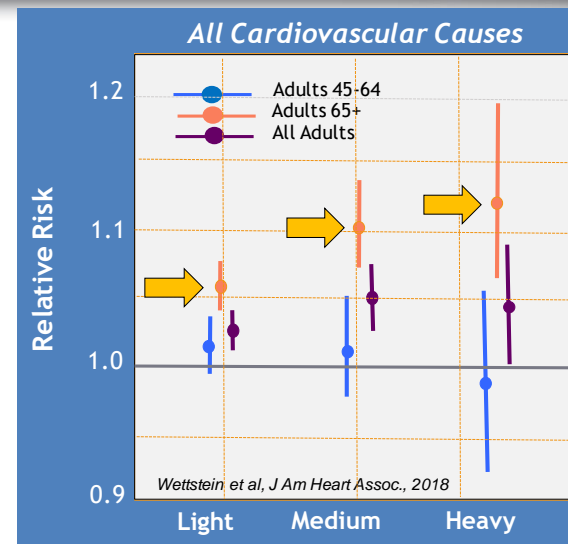Plume Transport (WRF/CMAQ) & Chemical Evolution (CMAQ)

Plume rise (CMAQ or SMOKE)

Emissions (BlueSky & SPECIATE)

Fuel & Consumption (BlueSky) Location/Area Burned (SmartFire)

Wildland Fire Sensors Challenge

link

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- Toxicology studies of the health effects of smoke from different fuel types and burn conditions link

- Epidemiology studies evaluating population-level health effects of wildland fire smoke link

- Solutions-driven research pilot focusing on effectiveness of indoor air filtration → June web summit on indoor air filtration link

- Smoke Sense – now in its 3rd season, available in Spanish

- 2019 Wildfire Smoke Guide

- Smoke Ready Toolbox for Wildfires

All Cardiovascular Causes

Relative Risk — Adults 45-64, Adults 65+, All Adults

Light, Medium, Heavy

Wettstein et al, J Am Heart Assoc., 2018

Smoke Sense
Air Quality Index 27612
Current AQI — AQI Tomorrow
Moderate — Unhealthy:Sensitive Grou
Particle 35 — Particle
Ozone 85 — Ozone
Symptom & Smoke Observations — Fire & Smoke Near Me
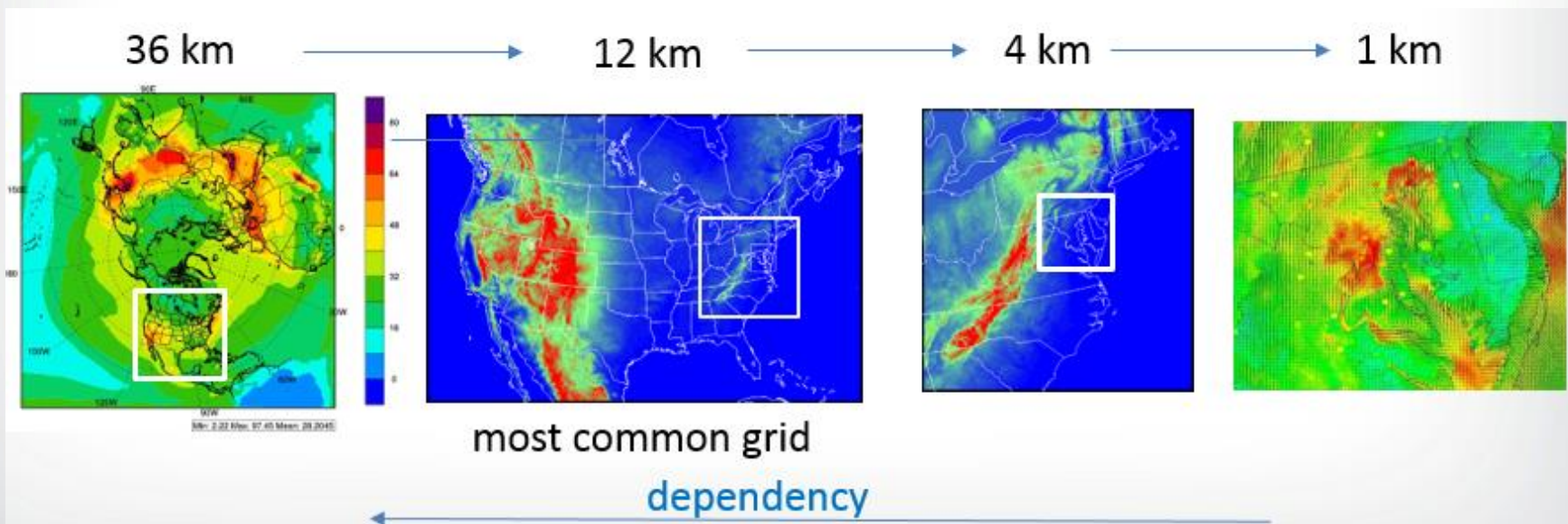Smoke Smarts — Air Quality 101

Community Multiscale Air Quality (CMAQ) Model

- <u>Open-source</u>, cutting edge – model founded on first principles (meteorology and empirical chemistry)
- Used for EPA's Office of Air Quality Planning and Standards assessments
- Used by 27 states for SIPs and Regional Haze – especially for O_3 and PM
- Multipollutant and multiple scales for broad application
- **Final CMAQ v5.3 anticipated to be released Fall 2019**

https://www.epa.gov/cmaq   https://github.com/USEPA/CMAQ/blob/5.3.b2/README.md

36 km → 12 km → 4 km → 1 km

most common grid

dependency

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Additional Information on A-E Research Areas

A-E Program Vision

➢ Advance the science needed to achieve clean air and attain the national ambient air quality standards, which will protect human health and ecosystems throughout the United States

➢ Address impacts that are influenced by changes to the nation's energy portfolio, technological advances, and environmental conditions

➢ Provide research results that:

  − Address EPA priorities and mandates;

  − Meet partners' needs;

  − Fill knowledge gaps; and

  − Complement broader efforts across the Federal government, as well as research being conducted by the larger scientific community

EPA

- RA 1: **Approaches to support air quality management programs for multiple pollutants at multiple scales**
  - Develop and evaluate methods and models to support air quality management programs
    - Conduct research to advance understanding of atmospheric science and incorporate into periodic updates to CMAQ and dispersion models (AERMOD)
    - Advance approaches to estimate background contributions of PM and O_3

- RA 2: **Approaches for characterizing source emissions, air quality, exposure, and mitigation strategies**
  - Develop, evaluate, and apply improved measurement methods
    - **Criteria pollutants** - Designations and methods development for Federal Reference Methods (FEMs) and Federal Equivalent Methods (FEMs)
    - **Hazardous air pollutants (HAPs)** – methods development, including fenceline measurements to identify and characterize previously undetected leaks from sources
  - Provide tools for state/tribal/local stakeholders' use to identify and evaluate effective emissions reduction strategies

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EPA

- RA 3: **Public health and environmental responses to air pollution**
  - Improve understanding of local and regional characteristics influencing impacts on public health in healthy and at-risk populations
  - Expand understanding of impacts at lower ambient concentrations
  - Enhance knowledge of the potential health impacts of multi-day pollution events (such as wildfires) in relationship to single-day events and longer-term exposures
  - Improve characterization of the relationships between ambient concentrations, deposition, and ecosystem impacts
  - Inform effective and consistent public health messages for actions to reduce risks and public health impacts

- RA4: Public health and ecosystem exposures and responses to emerging air pollutants and sources
  - focuses on "new" pollutants and sources – those whose risks were unknown/unclear or that were not previously of concern
  - PFAS, ethylene oxide as examples: determine sources, measurement and quantification methods, control approaches

- RA5: Methods to evaluate environmental benefits and consequences of a changing energy system
  - examines large-scale changes in the energy system and the potential challenges and benefits to the environment
  - potential advances in energy technologies, growth and evolution of energy production and use, and associated environmental consequences

- RA6: Methods to Enable Resilience to Future Environmental Stressors
  - investigates how changes in the atmosphere – extreme events, mean precipitation and temperature – can affect EPA's ability to fulfill its mission
  - Impacts of increasing temperatures and extreme events (including wildland fire) on air quality, water quality and treatment, aquatic ecosystems; and ultimately on health

- RA7: Emerging approaches to improve air quality and exposure characterization
  - evaluating and providing performance targets for new sensor technologies for air quality monitoring that provide more real time, very localized data, but with widely varying performance
  - Developing methods for modeling and measurement fusion to combine data from all monitoring instruments and satellites to represent ambient air pollution
  - Developing new air quality model that is more efficient, covers multiple pollutants at multiple scales; will link with new global meteorological models

- RA8: Novel approaches to assess human health and ecosystem impacts and risks
  - building from the HHS Million Hearts Initiative which advises high risk patients to avoid PM2.5. This opens doors with medical community and new research partners (e.g, NHLBI)
  - using new developments in individualized medicine, health analytics and technology to foster new health research approaches using electronic health data systems for epidemiology
  - combining air quality sensor and individual health data
  - integrating ecosystem and forest service models to assess impacts of fires and enable environmental managers to identify vulnerable areas; including impacts to ground and surface water quality and overall ecosystem-health challenges

An Issue of Increasing National Concern

- Wildland fires are increasing in frequency, size, and intensity in the US

- 2014 National Emissions Inventory estimates that, on average, >30% of $PM_{2.5}$ is associated with emissions from wildland fires

- Cutting across and drawing from the 3 Research Topics an integrated science focus on wildland fires will explore:
  - What ecosystems and human populations are vulnerable to wildland fires?
  - What approaches can be used to mitigate risks to human health and ecosystems?
  - How and to whom do we communicate these approaches/guidance to reduce risks?

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