

This is the
program overview
as presented at
the meeting in
April 2020.

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

Program Director

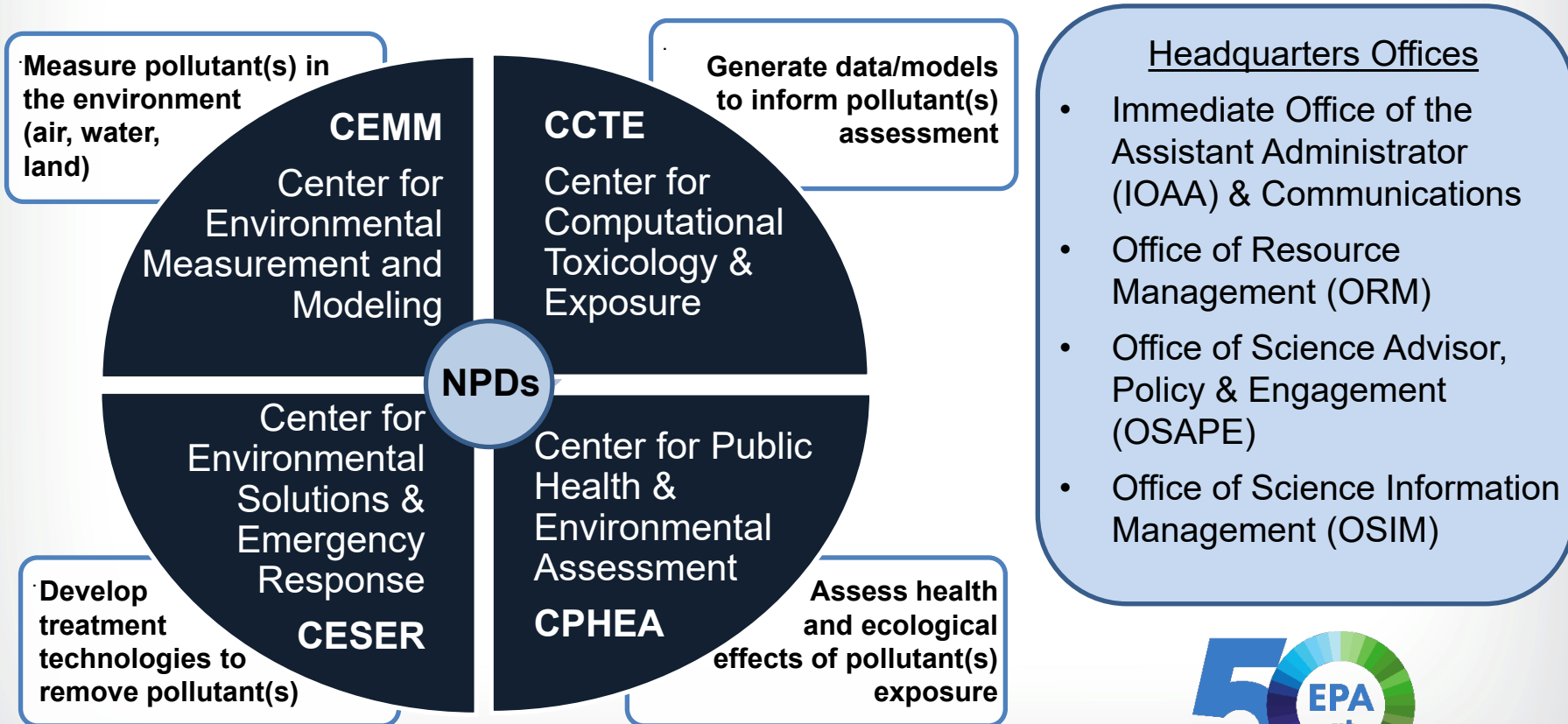
Note: this document may contain some elements that are not fully accessible to users with disabilities. If you need assistance accessing any information in this document, please contact ORD_Webmaster@epa.gov.





ORD Reorganization

This new organizational structure is designed to enhance our scientific leadership, better integrate scientific approaches to problems, support mission and partner focused solutions, create communities of practice, and align the size and structure to optimize the use of our workforce.



Air and Energy National Research Program

National Program and Center Directors



Bryan Hubbell
*A-E National
Program Director*



Tim Watkins
*Director of Center for
Environmental
Measurement and
Modeling (CEMM)*



Wayne Cascio
*Director of Center for
Public Health and
Environmental
Assessment (CPHEA)*

Air and Energy NPD Team



Sherri Hunt
*Principal Associate
National Program Director
(acting)*



Andy Miller
*Associate National
Program Director
for Climate*



Christine Alvarez
*Associate National
Program Director (acting)*

Connections to Centers and Offices

CEMM



Beth Hassett-Sipple
*CEMM Assistant Center
Director for Air and Energy*

CPHEA



Tom Long
*CPHEA Assistant Center
Director for Air and Energy*

CPHEA



Darrell Winner
*CPHEA Research
Area Coordinator
for Air and Energy*

OSAPE



Serena Chung
*OSAPE Matrix Interface for
Air and Energy (acting)*



Elisa Lazzarino
*Engagement & Social Science,
A-E National Student Services
Contractor*



Lynn Tran
*Internal Media Developer,
A-E National Student Services
Contractor*



Overview

- Process of moving from Strategic Research Action Plan (StRAP) to research implementation
- Program vision and structure
- Intramural research
- Extramural research
 - Science to Achieve Results (STAR) grants
 - Small Business Innovation Research (SBIR) and prize-based challenges
- EPA region/state/tribal collaborations
- Plan for BOSC Review of A-E Portfolio



Moving from StRAP to Implementation

- Research Area Coordination Teams (RACTs) 2019
 - Define details of research Outputs and Products
 - Broad representation on all RACTs
 - Research area coordinator
 - ORD senior scientists and A-E program representatives
 - EPA program and regional representatives
 - State scientist pilot, directly on RACT
- Additional input obtained through Tribal Consultation in Nov/Dec
- Working toward ORD Strategic Metric
 - “Increase percentage of products that meet customer needs”
 - Measured annually through survey of quality, usability, timeliness
- Developing an engagement strategy to ensure continued connections with programs, regions, state and local agencies, tribes, and other interested groups



ORD Planning Cycle

- Plan is for FY19-22
- Includes products beginning in different years, based on available funding and sequencing of research activities
- Funding uncertainty means there will likely be changes in timing and scope of work
- We engage with EPA program and regional offices (PO/ROs) to ensure that priority needs are considered in any changes to timing or scope



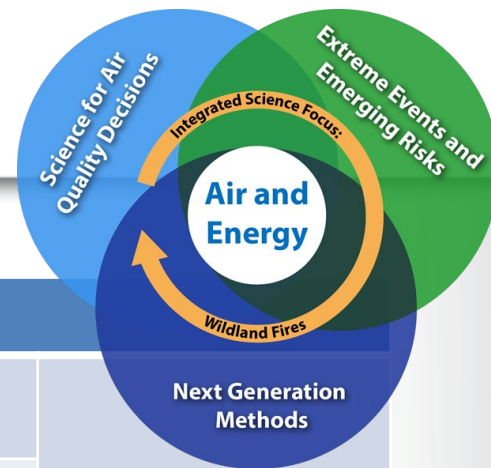
Program Vision

- 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 RO/PO needs;
 - Fill knowledge gaps; and
 - Complement broader efforts across the Federal government, as well as research being conducted by the larger scientific community





Program Structure



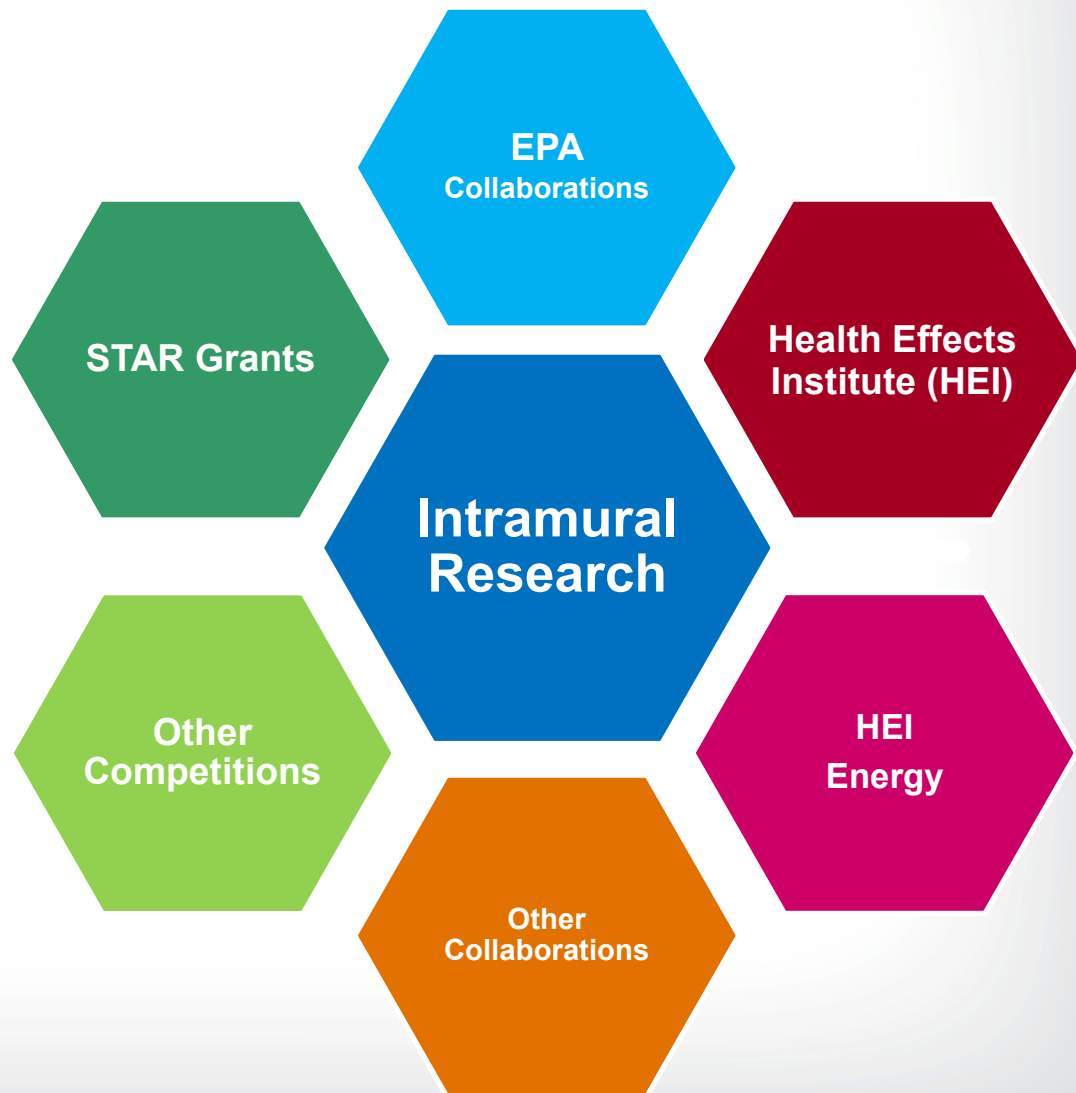
| Topic | Research Areas | | | |
|--|--|---|---|---|
| Science for Air Quality Decisions | #1: Approaches to support air quality management programs for multiple pollutants at multiple scales | #9: Wildland Fires (Integrated Science Focus) | | |
| | #2: Approaches for characterizing source emissions, 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 | | #9: Wildland Fires (Integrated Science Focus) | |
| | #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 | | | #9: Wildland Fires (Integrated Science Focus) |
| | #8: Novel approaches to assess human health and ecosystem impacts and risks | | | |



Many Components Contribute to the A-E Research Portfolio

Strategically integrate intramural and extramural research efforts to create a robust portfolio

- ***EPA Collaborations*** with other national research programs, POs and ROs (e.g., RARE, R2P2)
- ***HEI Air/Energy***: unique public-private partnerships
- ***Other Collaborations*** with other agencies, industry, academia (e.g., CRADAs, MOUs/MOAs)
- ***Other Competitions*** e.g., Pathfinder Innovation Projects (PIPs), challenge and prize competitions, citizen science, SBIR, P3
- ***Star Grants***: single principal investigator, Interdisciplinary Centers





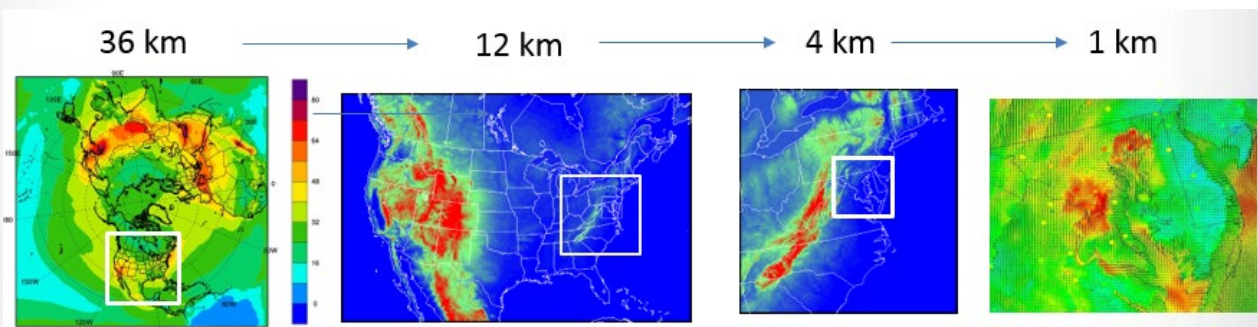
Intramural Research



RA 1: Approaches to support air quality management programs for multiple pollutants at multiple scales (1 of 2)

Priorities: Development, evaluation, and application of air quality and multimedia models for regulatory and research applications including deposition of nutrients to sensitive ecosystems

- Continue development of Community Multiscale Air Quality (CMAQ) model
 - Released v5.3 in 2019 with improvements in aerosol characterization
 - Model evaluation continuing in 2020
 - Improving aerosol chemistry and treatment of ultrafine particles
 - Improving modeling of deposition, background pollution and contributions of sources
 - Improving understanding of ozone formation and transport



- Improve characterization of mixing heights and NO₂ and formaldehyde column measurements
- Develop tool for enhancing public access to satellite data and extension of fusion methods to include satellite data



RA 1: Approaches to support air quality management programs for multiple pollutants at multiple scales (2 of 2)

- Dispersion plume modeling (AERMOD) and near-source modeling
 - Expanding characterization of near-source impacts
 - Development of algorithms for roadside solid and vegetative barriers
 - Flow and dispersion of air pollutants in urban areas (collaboration with Homeland Security)



Visualizations from the Page Road Wind Tunnel Facility

- Rubbertown Next Gen Emission Measurement (NGEM) demonstration project
- KC-TRAQS project using fixed and mobile AQ measurement, as well as AERMOD to understand impacts of freight movement
- Impacts of roadways on near-road ambient AQ using back trajectory and dispersion models



RA 2: Approaches for characterizing source emissions, air quality, exposure, and mitigation strategies (1 of 2)

Priorities: Federal Reference and Equivalent Methods research for criteria pollutants, methods development for hazardous air pollutants, and methods to measure area source emissions

- Ambient, source, and near-source measurement methods
 - FRM/FEM for criteria pollutants
 - Formaldehyde method development and evaluation
 - Benzene fenceline measurements
 - Continued development of next generation emissions measurement, fugitive, area source, and fenceline methods
- Wildland fire smoke measurements
 - Evaluation of battery-operated PM samplers in areas impacted by wildland fire smoke
 - Measurement of ozone, PM, and N and S compounds in wildland fire smoke
 - Evaluating performance of sensor pods from the EPA Wildland Fire Air Sensor Challenge





RA 2: Approaches for characterizing source emissions, air quality, exposure, and mitigation strategies

- Evaluating key gaps in emissions information
 - Non-road engines
 - Stationary diesel generators
 - Stationary source condensible PM
 - Pellet burning biomass boilers
 - NO_x, VOC, SVOC, PM from light and heavy-duty vehicles
 - Pellet stoves (ISO method)
 - Co-combustion of coal and biomass
- Updates to the SPECIATE database (organic gas and PM speciation profiles)
- VOC measurement using automated portable gas chromatographs
- Emissions methods for swine, poultry, and dairy farms
- Improved methods for measurement of methane emissions and development of emission inventories for methane for surface water reservoirs





RA 3: Public health and environmental responses to air pollution (1 of 2)

Priorities: Factors affecting vulnerability of people and ecosystems including biological, exposure/deposition characteristics, and environmental justice

Public Health Responses

- **Vulnerability to air pollution**

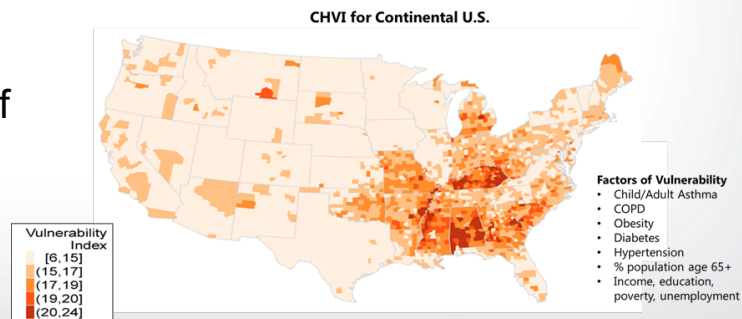
- Potential modifiers:
 - Sociodemographic factors
 - Acute and chronic stressors
 - Diet and nutritional status
 - Noise, psychosocial stress
 - Underlying health conditions such as obesity
 - Temperature and extreme weather conditions

- Health endpoints:

- Respiratory
- Cardiovascular
- Reproductive
- Maternal health
- Developmental susceptibility
- Long-term wellness and chronic disease

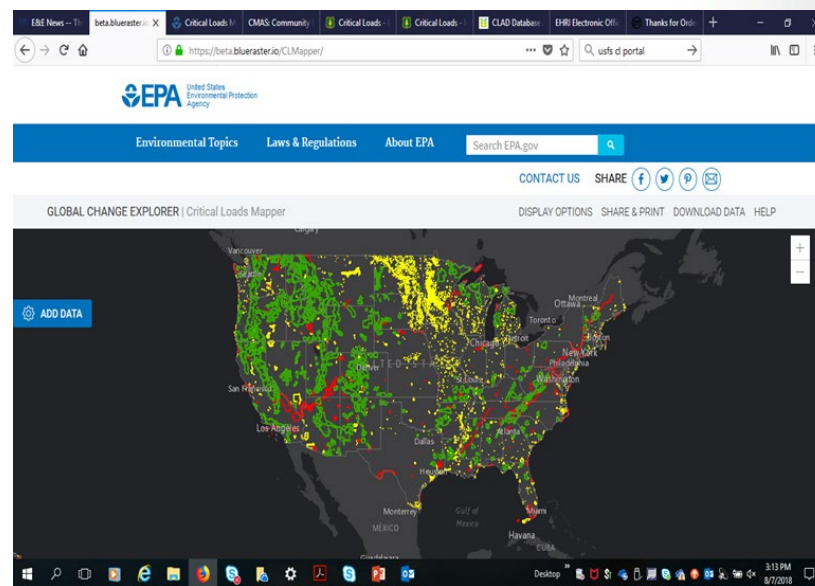
- **Timing of exposures**

- Multi-day vs single day exposures and impacts of air filtration interventions
- Impacts of peak exposures in vulnerable populations
- Mixtures and sequential exposures



Environmental Responses

- Informing deposition and environmental impacts assessments with the Critical Loads Mapper web tool and National Critical Loads Database
- Improving measurement and modeling of air surface exchange and deposition
- Producing 12km CMAQ5.3 simulations of deposition for 2002-2017



<https://clmapper.epa.gov>



RA 4: Public health and ecosystem exposures and responses to emerging air pollutants and sources

Priorities: Develop methods to measure pollutants of emerging interest including per- and polyfluoroalkyl substances (PFAS) and ethylene oxide

- **PFAS**
 - Emissions, ambient, and deposition measurement methods
 - Fate and transport

- **Ethylene Oxide**
 - Emissions from point, mobile, and fugitive sources
 - Measurement methods

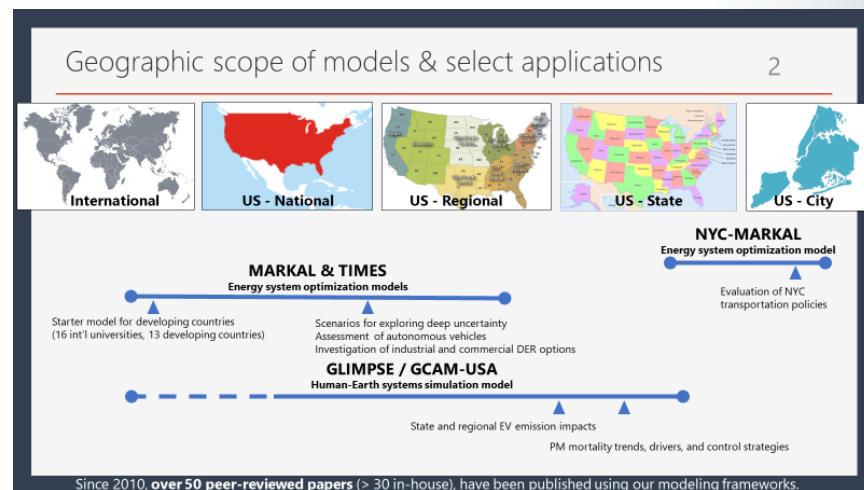
- **Evaluation of organic species impacting criterial pollutant formation**
 - Volatile chemical products (VCP) impacts on ozone and PM
 - Summary of STAR grantee findings on chemical mechanisms to address new challenges in AQ modeling
 - Mapping emissions to chemical mechanism surrogates



RA 5: Methods to Evaluate Environmental Benefits and Consequences of a Changing Energy System (1 of 2)

Priority: Development of scenarios of energy-system evolution of power generation, transportation, industry, and building sectors

- MARKAL/TIMES/GCAM
 - Linking energy and air quality models
 - Projecting non-EGU emissions
 - Evaluating cost and emission savings from energy efficiency and renewable energy
 - Scenario methods to evaluate the efficacy of regulations and policies in improving air quality
 - Improvements to the GLIMPSE framework and updates to GCAM-USA
 - Application of MARKAL to NYC ozone nonattainment
 - Feasibility and impacts of low-emission hydrogen production technologies





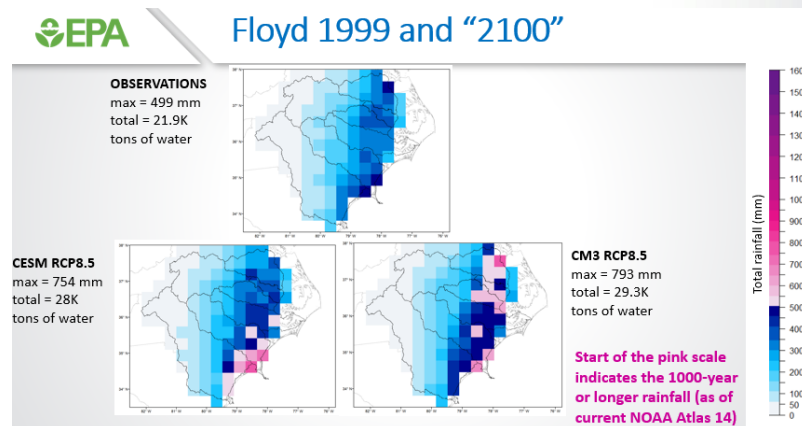
RA 5: Methods to Evaluate Environmental Benefits and Consequences of a Changing Energy System (2 of 2)

Priority: Development of scenarios of energy-system evolution of power generation, transportation, industry, and building sectors

- Biofuels report to Congress
 - Triennial report on the environmental and natural resource impacts of the Renewable Fuel Standard
 - ORD leading 50+ authors as part of a joint EPA/USDA/DOE effort to understand impacts to air quality, water quality and quantity, soil, and biodiversity
 - Expanded scope from 2018 report

Priority: Resilience and adaptation to extreme events and climate change

- Providing projections of possible future conditions
 - Future scenario data for population, land use, and extreme events (including tools for accessing scenario data)
 - Downscaled and high-resolution projections of extreme weather
 - Air quality and health impacts in the U.S. in 2050 and 2090 under two meteorological scenarios
 - Air quality and health impacts of wildfire in the U.S. under different temperature scenarios



- Preparing for environmental change
 - Mapping areas in the U.S. Atlantic and Gulf coasts vulnerable to flooding and inundation
 - Developing adaptation measures for resilient stormwater infrastructure and water quality programs
 - Identifying best management practices for resilient water infrastructure
 - Creating national scale assessment of the potential effects of hydroclimatic change on stormwater runoff in different U.S. regions



Figure 2. SLOSH modeling results of storm surge inundation for category 4 hurricane and 4-ft sea level rise scenario, with impacts to the wastewater collection and transfer systems. Citizens were engaged in historical flood level identification as a part of the citizen science project.





RA 7: Emerging Approaches to Improve Air Quality and Exposure Characterization (1 of 2)

Priority: Development of innovative and advanced approaches to measure and model air pollutants

- Air sensors
 - Performance targets and test protocols for criteria pollutants
 - Update to air sensors guidebook
 - Evaluations
 - Addressing needs for managing and analyzing data from air quality sensors
- Data fusion
 - Working with NASA and NOAA to incorporate satellite data along with FRM/FEM, sensor, and AQ model data to improve characterization of air quality at local scales to inform health studies
- Using next-generation methods and citizen science data to evaluate source emissions and impacts





RA 7: Emerging Approaches to Improve Air Quality and Exposure Characterization (2 of 2)

- Advanced air quality modeling approaches (global to urban scales)
 - New approach for modeling air quality at the global to regional and local scales being developed to take advantage of advances in global meteorology modeling, state-of-the-art air quality process knowledge, and modern software engineering principles
 - Prototype is being developed to link next generation meteorology Model for Prediction Across Scales (MPAS) and CMAQ
 - New model will incorporate improvements in chemistry and characterization of urban and landscape characteristics



RA 8: Novel Approaches to Assess Human Health and Ecosystem Impacts and Risks

Priority: Development of advanced capabilities to characterize public health and ecosystem risks

- Human Health
 - Using detailed individual information from electronic health records together with traditional data to explore novel impacts and susceptibility to health effects of air pollution
 - Using novel data systems, cellular methodologies, and cohort approaches to identify biomarkers and at-risk populations

- Ecosystems
 - Wildfire-water quality portal for effects on stream and lake water
 - Fuel load and air quality assessment tools for informing local and regional prescribed burning and smoke management planning
 - Analysis of effects of fire-induced land surface changes on air quality impacts



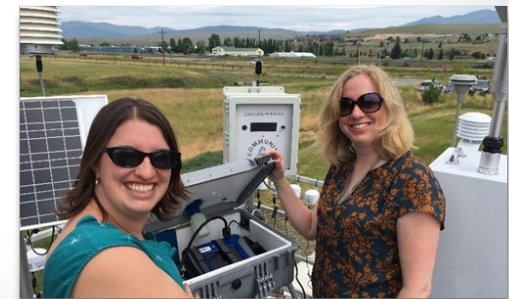
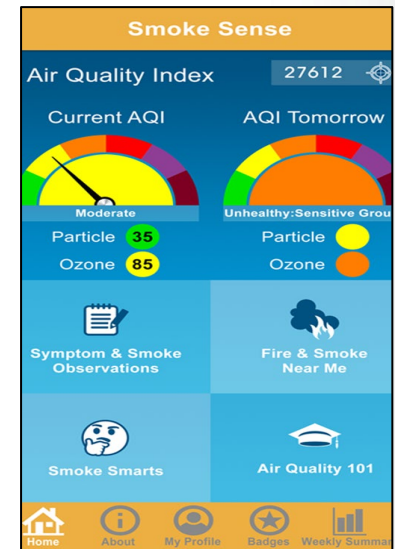
Priority: Approaches to reduce exposures and risks from wildland fires to people and ecosystems

- Key output: Interim progress update on wildland fire research summarizing multidisciplinary research being conducted across A-E research areas
 - Synthesis of science on emission factors, chemistry and human and ecological health hazards from fires at the wildland urban interface
 - Literature assessment of wildland fire effects on air quality, water quality, and human health
- Emissions and air quality impacts
 - Development of multi-year fire activity and emissions inventory
 - Evaluation of criteria pollutant concentrations attributable to wildland fires and residential biomass home heating

- Evaluation of health impacts of wildfires in vulnerable populations using advanced estimates of individual level air pollution exposures
- Continuing Smoke Sense study
 - Providing real time information on wildfire smoke
 - Evaluating strategies for effective health risk communication with individuals and organizations
- Evaluating potential benefits and costs of management action with an integrated modeling platform including the multi-media effects of wildfire
- Evaluation of clean air spaces -- Assessing portable air cleaners (PACs) or central air filtration systems during smoke events



Smoke Sense





Extramural Programs



Ongoing or Recently Ended A-E STAR Grants

| Request for Applications (Short) Title | Goal | Expected End Date |
|---|--|----------------------|
| Long-Term Cardiovascular Impacts | reduce uncertainty regarding the relationship between air pollutants and cardiovascular disease | August 2021 |
| Air, Climate, and Energy Centers | understand regional differences in air pollution and the effects of changes and variations in meteorology, technology, and societal choices on local and regional air quality and health | April 2023 or before |
| Air Pollution Monitoring for Communities | work with local communities to explore the use of low-cost sensors and to improve understanding of how data can be gathered and used by communities to learn about local air quality | April 2021 |
| PM in a Changing World | enhance scientific knowledge regarding the challenges that various aspects of global change pose to management of PM and related pollutants | April 2021 |
| Indoor Air and Climate Change | to improve understanding of the effects of climate change on indoor air quality and the resulting health effects | October 2019 |
| Household Energy | to understand how effective cleaner burning methods are in protecting air quality and slowing climate change | September 2019 |



Upcoming A-E STAR RFAs/Grants

- **Chemical Mechanisms to Address New Challenges in Air Quality Modeling (FY19)**
 - Goal: To improve chemical mechanisms used in air quality models (e.g., CMAQ, WRF-Chem, GEOS-Chem)
 - Scope: Six regular and three early-career awards are being recommended for funding, covering general fundamental chemical reaction mechanisms as well as chemistry of volatile chemical vapors (VCPs), wildfire emissions, isoprene, and halogens
 - Status: Anticipate awards will be in place this spring
- **Upcoming A-E STAR Grants (FY20)**
 - Status: Currently under development; anticipate RFA will open for solicitation this spring and awards will be made in spring 2021



SBIR and Challenges/Prizes

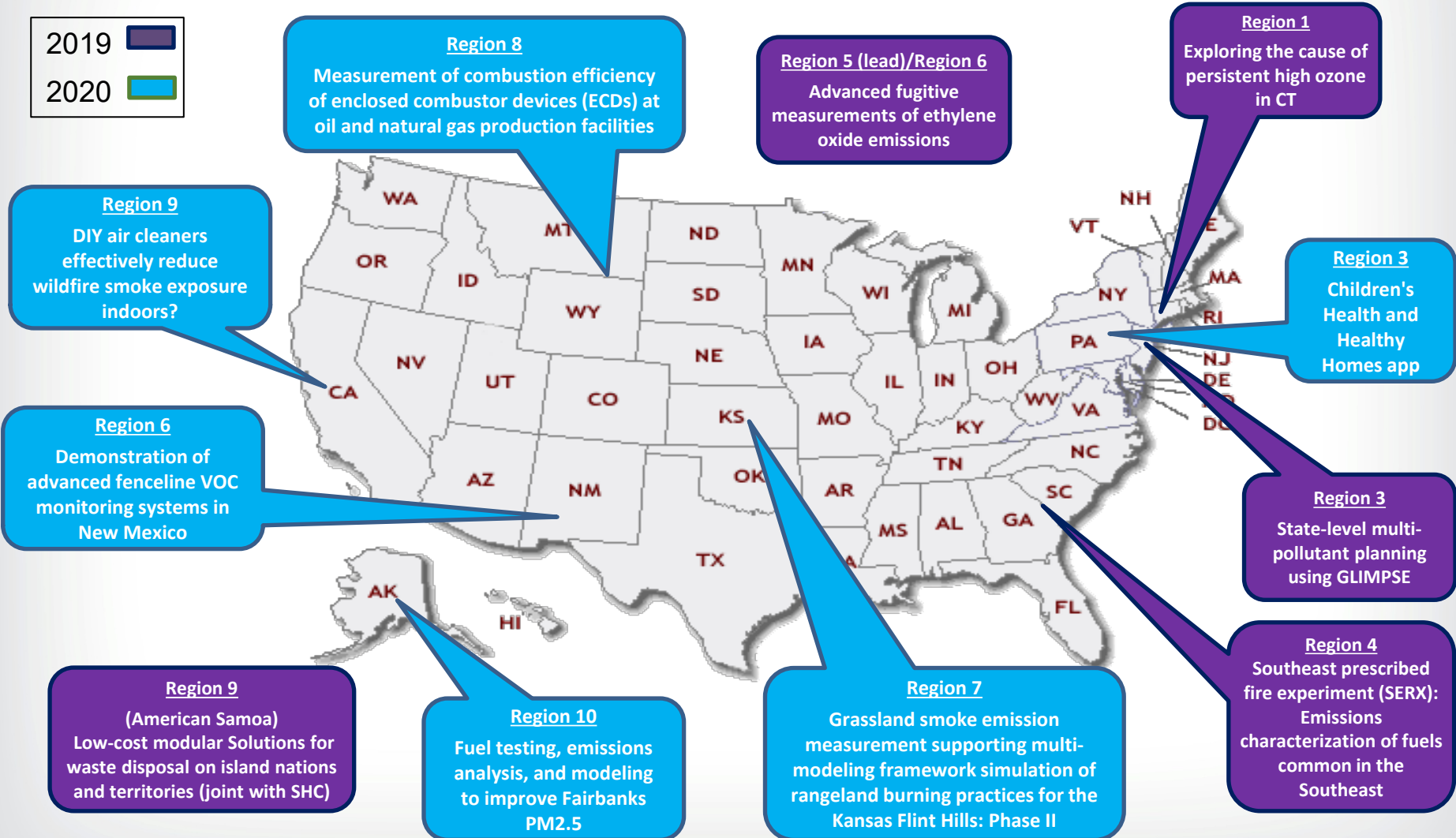
- **SBIR: encourages small businesses to develop innovative, commercializable environmental technologies that address priority needs across the Agency**
- **Air topics solicited and funded contracts under SBIR during 2016-2019 include:**
 - Integrated cooking, heating, and electric power generation
 - Inexpensive indoor formaldehyde sensor
 - Low-cost sensor for identifying fugitive methane emission
 - Innovative measurement tools for ground level air pollution levels from wildland fires
 - Air monitoring technology for ethylene oxide
 - Air monitoring technology for sulfur dioxide
- **Prize-based challenges are open competitions that seeks to engage the broadest possible community of innovators to solve a particular problem or challenge**
- **Recent Challenges**
 - Wildland Fire Sensors Challenge (with NASA, USFS, NOAA, NPS, CDC, & Tall Timbers Research Station)
 - FY20 or later: Exposure reduction during wildfire smoke episodes



EPA Region/State Collaborations



A-E Regional Applied Research Efforts (RARE) Research – FY19/FY20

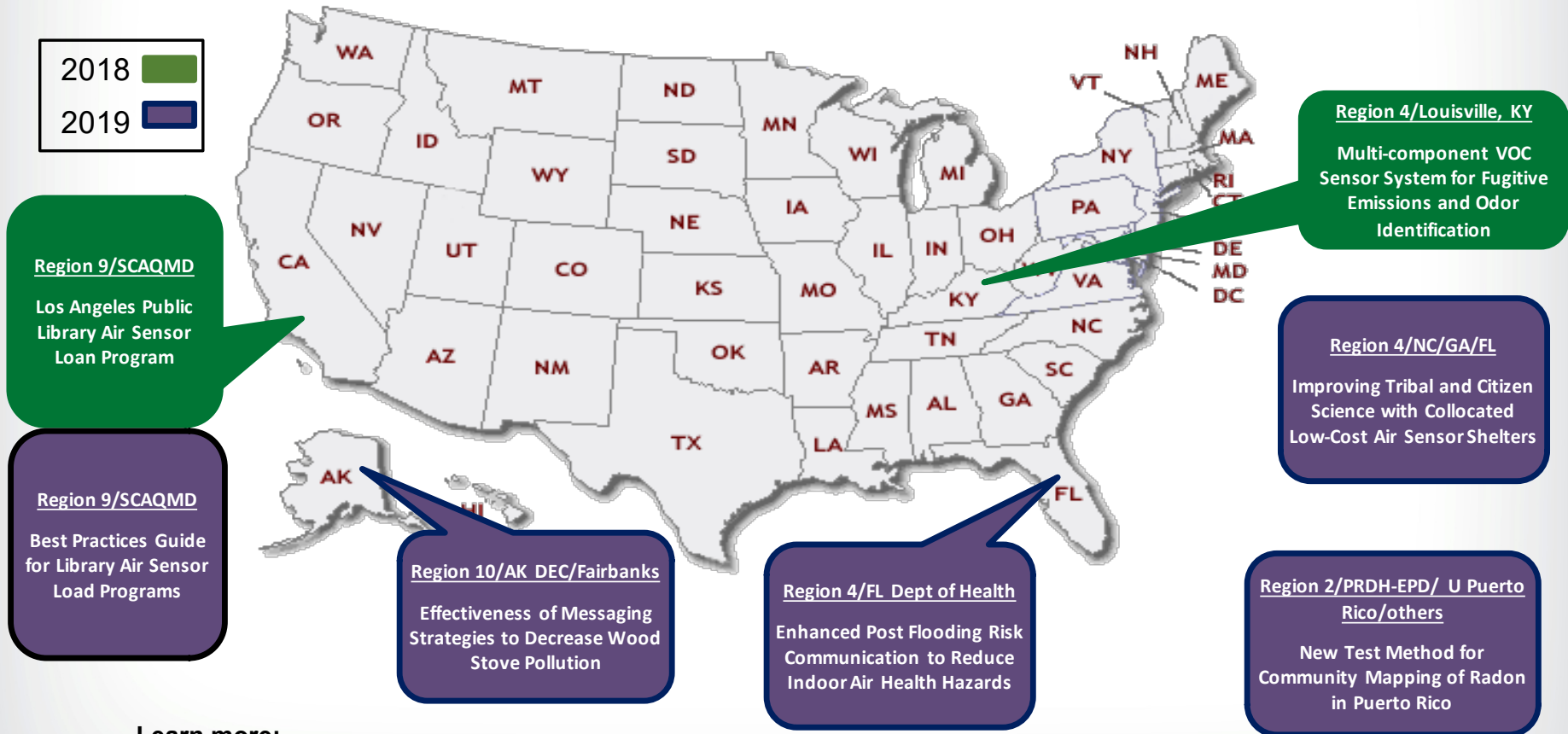




A-E Regional-State-Tribal Innovation Projects (RSTIP) 2018/2019

State and Tribal Partnerships for Environmental Priorities

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



Learn more:

2018: <https://www.epa.gov/innovation/2018-regional-state-innovation-projects>

2019: <https://www.epa.gov/innovation/2019-regionalstatetribal-innovation-projects>



Summary

- The Air and Energy portfolio covers a broad range of research addressing key science questions across the spectrum of:
 - emissions and air quality characterization, including accounting for changing environmental conditions
 - health and environmental exposures and effects
 - understanding the sources that affect air quality, including the impacts of changes in the energy system
 - approaches for addressing emissions from those sources
- These research activities are well aligned with our program objectives to assess impacts, expand approaches to prevent and reduce emissions, advance measurement and modeling, and inform decisions
- The complementary research activities supported through the combination of intramural and extramural program elements provide the greatest opportunities to address both near-term and longer-term science needs
- The A-E program is committed to sustained engagement with RO/PO, state and local agencies, tribes, and other interested groups
 - As new needs arise, we will work with these groups to consider changes to the portfolio to address priorities
 - Changes in resource availability can present challenges or opportunities – engaging users of our research at these times will improve buy in for any changes in the A-E portfolio



Plan for BOSC Review of A-E Portfolio

- **Meeting 1 (target August 2020)**
 - Research Area 4 (Public Health and Environmental Exposures and Responses to Emerging Air Pollutants and Sources)
 - Research Area 2 (Approaches for Characterizing Source Emissions, Air Quality, Exposure, and Mitigation Strategies)
 - Engagement Strategy
- **Meeting 2 (target March 2021)**
 - Wildland fire focus
 - Research Area 1 (Approaches to Support Air Quality Management for Multiple Pollutants at Multiple Scales)
 - Research Area 3 (Public Health and Environmental Responses to Air Pollution)
 - Research Area 7 (Emerging Approaches to Improve Air Quality and Exposure Characterization)
 - Research Area 8 (Novel Approaches to Assess Human Health and Ecosystem Impacts and Risks)
 - Research Area 9 (Wildland Fires)
- **Meeting 3 (target September 2021)**
 - Resilience focus
 - Research Area 5 (Methods to Evaluate Environmental Benefits and Consequences of Changing Energy Systems)
 - Research Area 6 (Methods to Enable Resilience to Future Environmental Stressors)



For More Information

Bryan Hubbell

National Program Director

hubbell.bryan@epa.gov

Sherri Hunt

Principal Associate National Program Director

hunt.sherri@epa.gov

Andy Miller

Associate National Program Director for Climate

miller.andy@epa.gov

Christine Alvarez

Associate National Program Director

alvarez.christine@epa.gov