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Overview of EPA's Research Agenda Considering Intersecting Priorities of Climate Change and Environmental Justice

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Outline

High-level Overview

- Agency context for climate and health research
- Research accomplishments
- Future plans
- Wrap-up

Case-in-Point

American Lung Association State of the Air Report (April 21, 2022)

- >40% of Americans—over 137 million people—are living in places with failing grades for unhealthy levels of particle pollution or ozone
- The three years covered by “State of the Air” 2022 ranked among the seven hottest years on record globally. Spikes in particle pollution and high ozone days related to wildfires and extreme heat are putting millions more people at risk.
- Americans experienced more days of “very unhealthy” and “hazardous” air quality than ever before in the two-decade history of “State of the Air."
- People of color are 3.6 times more likely than white people to live in a county with 3 failing grades

Source: https://www.lung.org/research/sota/key-findings

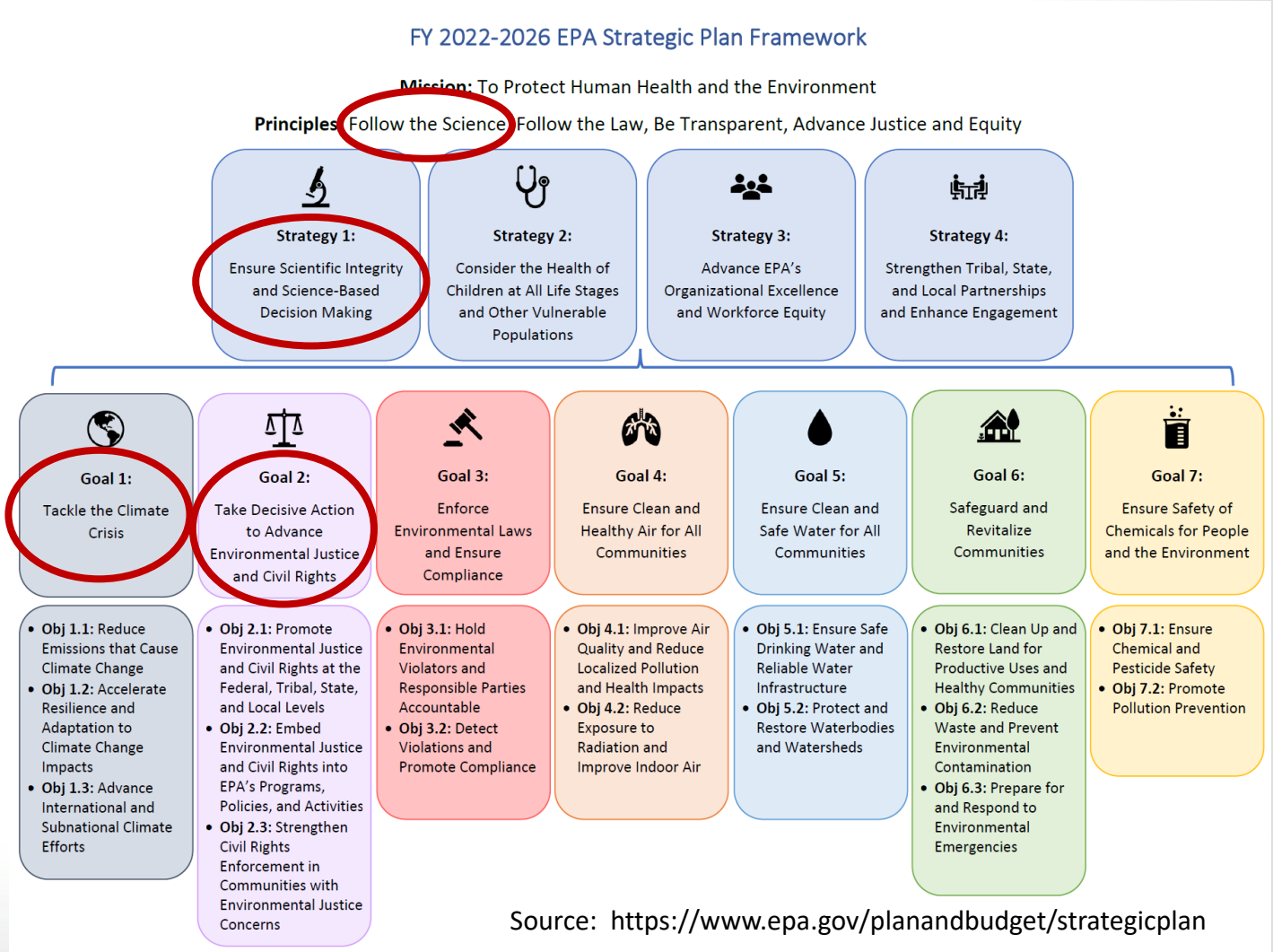
Executive Orders

- Tackling the Climate Crisis at Home and Abroad (#14008, issued January 27, 2021)
  - Created the Office of Domestic Climate Policy. Gina McCarthy appointed as National Climate Advisor
- Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis (#13990, issued January 20, 2021)
- Strengthen America's Forests, Boost Wildfire Resilience, and Combat Global Deforestation (issued April 22, 2022)

EPA's Strategic Plan (FY22-26)

Relevant Considerations

- Science and integrity valued
- Climate change and EJ among highest priorities



Source: https://www.epa.gov/planandbudget/strategicplan

FY23-26 Research Planning Programs

ORD's National Research Programs are developing Strategic Research Action Plans (StRAPs) for FY23-26.

Research Topics by Program

Air, Climate and Energy (ACE)

- Understanding Air Pollution and Climate Change and Their Impacts on Human Health and Ecosystems
- Responding to Risks and Impacts and Preparing for the Future

Chemical Safety for Sustainability (CSS)

- Chemical Evaluation
- Complex Systems Science
- Solutions-Driven Translation and Knowledge Delivery

Homeland Security (HS)

- Contaminant Characterization and Risk Assessment
- Environmental Cleanup and Infrastructure Remediation
- Community Engagement and Systems-Based Tools Supporting Resilience Equity

Human and Environmental Risk Assessment (HERA)

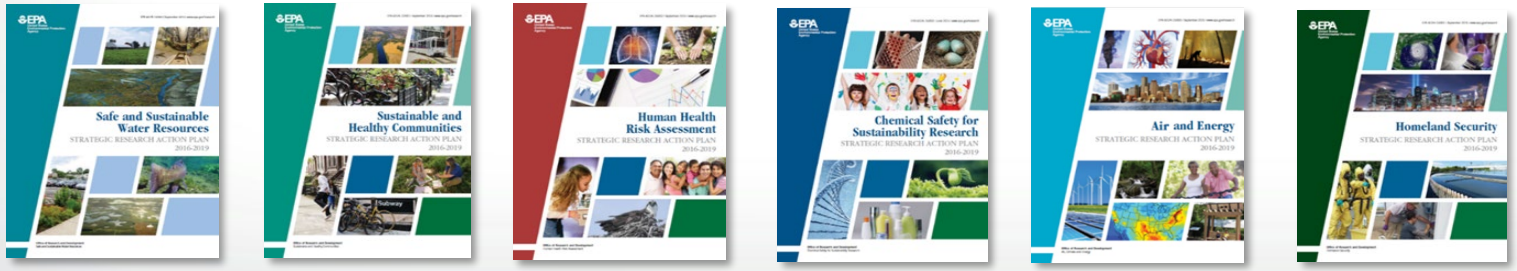
- Science Assessments and Translation
- Advancing the Science and Practice of Risk Assessment

Safe and Sustainable Water Resources (SSWR)

- Watersheds
- Nutrients and Harmful Algal Blooms
- Water Treatment and Infrastructure

Sustainable and Healthy Communities (SHC)

- Advancing Remediation and Restoration of Contaminated Sites
- Materials Management and Beneficial Reuse of Waste
- Integrated Systems Approach to Building Healthy and Resilient Communities



FY 2019-2022 StRAPs available on EPA's website

FY23-FY26 Research Planning: Cross-Cutting Issues

EPA/ORD's six National Research Programs (NRPs) will work together, where appropriate, through joint and targeted engagement activities with key Agency partners, external partners, and stakeholders to ensure that ORD's research portfolio appropriately addresses key topic areas.

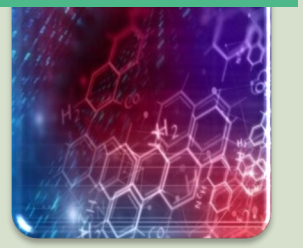
Cumulative Impacts

Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time.

Children's Environmental Health

Inform public health decisions and scientific understanding of potential early life susceptibility to environmental stressors, and community efforts that create sustainable and healthy environments protective of children's health.

Contaminants of Emerging Concern



Includes chemical substances that may cause ecological or human health impacts and are either known contaminants of increased priority or newly identified contaminants.

Environmental Justice

Coordinated efforts to better understand health disparities from unequal environmental conditions, including impacts from climate change and exposures to pollution and inequitable social and economic conditions.

Climate Change

Integration, where appropriate, to avoid duplicative efforts, fills critical gaps, and provides results that reflect the multiplicity of impacts and needs associated with climate change.

Community Resilience

Develop and implement methods that increase the sustained ability of a community to use available resources to respond to, withstand, and recover from adverse situations.

Air, Climate, and Energy National Research Program

EPA's Air, Climate, and Energy research program examines the interplay between air pollution, climate change, and the dynamic energy sector to develop innovative and sustainable solutions for improving air quality and taking action on climate change. The results of the research efforts support policies that have far-reaching and positive impact across the nation.

Climate Change Research Highlights

Research products:

- Measure and respond to smoke from wildfires
- Measure greenhouse gas (GHG) emissions
- Estimate future impacts of climate change on
  - Air quality
  - Extreme precipitation events
  - Ecosystems
  - Public health
- Evaluate water infrastructure resilience
- Understand the environmental impacts of the energy system transition

Multiple products address vulnerable populations and include community level research, including citizen science activities

27 active Science to Achieve Results (STAR) grants address water scarcity, air quality, and resilience in vulnerable communities

- ORD has issued a notice of intent for applications anticipated in FY22: Technical, Economic, and Social Drivers of Large-Scale Energy System Transformation in Under-Resourced Communities and Tribes

Health Impacts from a Changing Climate

Projecting Changes in Air Quality under Future Climate Scenarios

- Furthers the capacity for estimating air quality health impacts for various climate scenarios.
- Enhances understanding of climate change impacts on rates of formation of ozone and PM2.5.
- Science Inventory article (January 4, 2021)

Effects of Changing Environmental Conditions on Air Quality and Human Health

- Wildfires produce large amounts of particles and ozone precursors, but the health impacts of a mixture of pollutants and the interaction with temperature are not well characterized.
- Investigates health effects of exposure to wildfire smoke under various temperatures.
- Improves strategies to increase public awareness of air pollution-related exposures and risks, including under future warmer temperatures
- Improves strategies to support public health decisions that can reduce adverse public health and environment effects.

National Climate Assessment

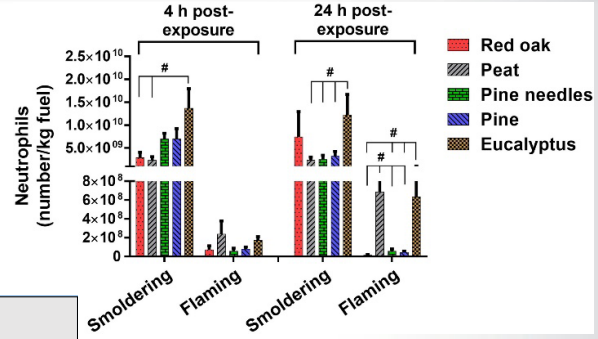
- Scheduled for publication in 2024.
- Includes chapters on Air Quality, Human Health, and regionally-focused chapters.
- Multiple EPA authors

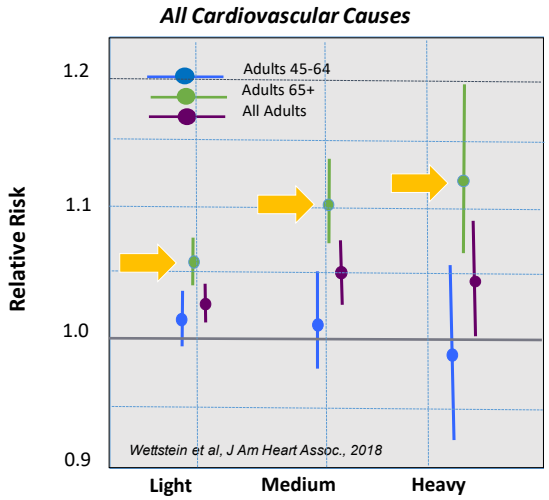
Wildfire Impacts on Human Health

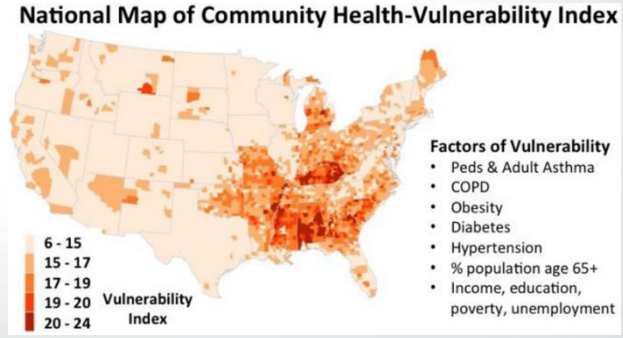
EPA/ORD is improving understanding of the impacts of wildland fire smoke on human health, especially in at-risk populations.

In parts of the U.S., wildfire-related PM makes up 30 percent of annual ambient PM, and during wildfire season in the West, it can be as much as 90 percent.

- Studies of PM emissions from various wood types (e.g., red oak, peat, pine, and eucalyptus) and wildfire combustion phases (e.g., flaming vs. smoldering), show differences in lung toxicity and mutagenic potency. https://ehp.niehs.nih.gov/doi/10.1289/ehp2200
- Short-term exposure to wildland smoke causes acute respiratory health effects, especially among those with asthma and chronic obstructive pulmonary disease. https://www.epa.gov/sciencematters/epa-researchers-contribute-american-thoracic-society-workshop-report-wildland-fire
  - Studies of how smoke affects cardiovascular health provide evidence of increased cardiovascular emergency department visits, especially in those 65 and older.
  - Exposure to peat smoke can cause significant changes in heart rate and blood pressure.
- Community Health Vulnerability Index can map locations with vulnerable populations at higher risk from wildland fire smoke exposure.







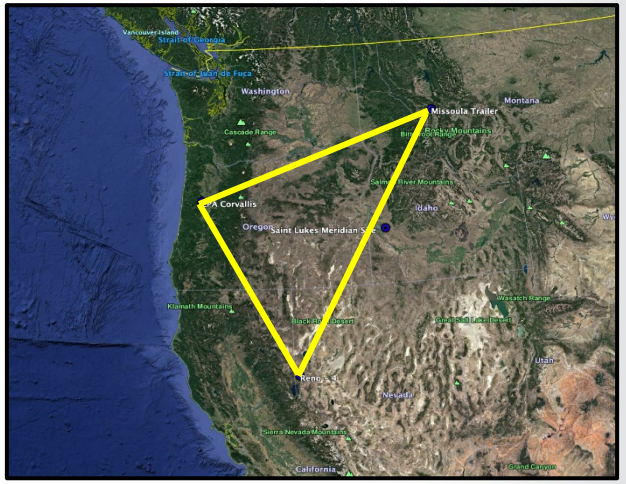
Low-cost Sensors

EPA/ORD is broadening new technology use for loan to state, local, and tribal air organizations with the Wildfire Smoke Air Monitoring Response Technologies (WSMART) Pilot.

- Help fill in air monitoring data gaps in areas affected by wildfire smoke.
- Supplemental monitoring with 3 air monitoring system types: PurpleAir $PM_{2.5}$, ThingyAQ $PM_{2.5}$, CO, VOC, and Vehicle Add-on Mobile Monitoring System (VAMMS) $PM_{2.5}$ https://www.epa.gov/air-sensor-toolbox/wildfire-smoke-air-monitoring-response-technology-wsmart-pilot

EPA/ORD is exploring low-cost sensors in wildfire smoke events in the Mobile Ambient Smoke Investigation Capability (MASIC) Study.

- Develop mobile measurement and temporary deployment capabilities.
- Evaluate instrument performance (FRM/FEM/sensors) under ambient smoke conditions at fixed community research sites in Boise, ID (Idaho DEQ); Missoula, MT (USFS); Reno, NV (Washoe Country Health Department.)
- Evaluate measurement technologies under controlled combustion conditions using chamber studies.
- Sponsor Wildland Fire Sensor Challenge for air measurement that is easier to deploy, suitable for use during high concentrations observed during wildfires, durable for field conditions, and can report data continuously and wirelessly. https://www.challenge.gov/challenge/wildland-fire-sensors-challenge/



MASIC Study area

Practices to Mitigate Risk of Wildfires

EPA/ORD is conducting research to mitigate smoke exposures, including evaluations of fire and smoke management strategies and personal and community interventions.

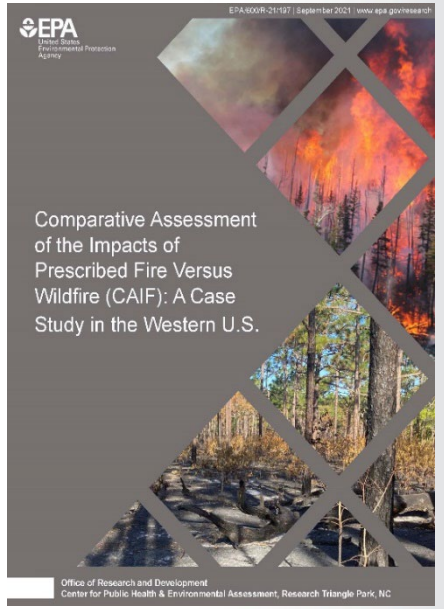
- Collaboration with USFS and DOI to examine the estimated air quality and health impacts of prescribed fire vs. wildfire: *Comparative Assessment of the Impacts of Prescribed Fire vs. Wildfire (CAIF): A Case Study in the Western U.S*.
- Collaboration with KS Dept of Health and Environment studying air quality impacts of rangeland burning in the Flint Hills region to inform how optimizing timing and burn conditions can mitigate smoke impacts.
- Investigation of effectiveness of air filtration systems to reduce PM2.5 concentrations during smoke events in the Wildfire ASPIRE (*Advancing Science Partnerships for Indoor Reductions of Smoke Exposures)* study; https://www.epa.gov/air-research/wildfire-study-advance-science-partnerships-indoor-reductions-smoke-exposures
- Study testing the effectiveness of a range of devices, including NIOSH-approved N95 or P100 respirators and surgical masks to improve understanding of the health benefits of facemasks and inform risk communication.

Prescribed burn in the Flint Hills region of Kansas; Photo: EPA

Wood burning smoke in Hoopa, CA; Photo: Brian McCaughey

Comparative Assessment of the Impacts of Prescribed Fire vs. Wildfire (CAIF)

EPA developed report in collaboration with over 50 scientific staff from EPA, U.S. Forest Service (USFS), Department of the Interior (DOI), and National Institutes of Standards and Technology (NIST.) The report compares air quality and health impacts between hypothetical scenarios of different fire management strategies.



Key Findings:

- Smoke impacts of wildland fire are (spatially and temporally) complex.
- Predicted concentrations of $PM_{2.5}$ from prescribed fires are smaller in magnitude and shorter in duration than hypothetical scenarios or actual wildfires.
- Well-designed prescribed fires targeted for specific locations may be able to reduce air quality and health impacts of subsequent wildfires.
- Smoke impacts on health are dependent upon population proximity to wildland fire events and meteorology (e.g., wind speed and direction.)
- Communicating the benefits of reducing wildland fire smoke exposure through individual actions and interventions (e.g., evacuation, air cleaners, filters for HVAC systems) that decrease $PM_{2.5}$ exposures can contribute to decreasing the public health impacts attributed to wildland fire smoke if these actions are more widely used by the population.

Indoor Reductions of Smoke Exposures: ASPIRE

EPA/ORD is engaging partners in solutions-driven research. ASPIRE focuses on evaluating clean air spaces during smoke episodes and investigating the effectiveness of air filtration systems to reduce PM2.5.

- Field studies (completed) in Missoula, MT and Hoopa, CA focused on commercial/public buildings; data analysis (underway)
- Laboratory studies to evaluate effectiveness of a variety of air cleaning technologies
  - *Wildfire Safety Research: An Evaluation of DIY Air Filtration* (July 2021)
- Work with ASHRAE committee to develop wildfire smoke guidelines for building managers
  - *Protecting Commercial Building Occupants from Smoke During Wildfire Events* (February 2021)
- Phase 1 winners for the *Cleaner Indoor Air During Wildfires* Challenge (October 2021)
  - https://www.epa.gov/air-research/cleaner-indoor-air-during-wildfires-challenge

Interconnected components of ASPIRE

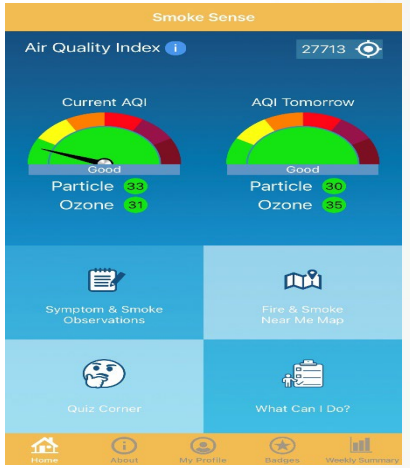
An Evaluation of DIY Air Filtration July 2021

DIY air cleaner made with an air filter clamped onto a box fan.

Challenge: Cleaner Indoor Air During Wildfires

Communicating Information

EPA/ORD is conducting research on the most effective ways to communicate information about air quality, health risks, and exposure-reducing actions.



- Smoke Sense; https://www.epa.gov/air-research/smoke-sense-study-citizen-science-project-using-mobile-app
- Smoke Ready Communities – Ongoing project working with state and local governments to understand how they can best incorporate communication into their smoke managements strategies.
- Smoke-Ready Toolbox; https://www.epa.gov/smoke-ready-toolbox-wildfires
- Science to Achieve Results (STAR) Interventions and Communication Strategies to Reduce Health Risks of Wildland Fire Smoke Exposures

STAR "Interventions" grants: Research Topics and Locations

Technological Interventions | Schools | Rx Prescribed Burns | Stakeholder Engagement
Communication Strategies | Homes | Gases | Health Impacts
Early Career | Regular

Household Atmospheric Dynamics under Elevated Smoke (HADES): Holistic Evaluation of Interventions for Reducing Indoor Levels of Wildland Fire Emissions
Elliott Gall, Portland State University
Portland, OR

School Resilience to Wildland Smoke and Outdoor Sources of Fine & Ultrafine Particles
Elena Austin, University of Washington
King & Yakima counties, WA; Yakama Nation

Development, Implementation, and Evaluation of Stakeholder-Driven Wildfire Smoke Monitoring and Messaging in Rural Nevada
Kristen VanderMolen, Desert Research Institute
Rural NV

A Community-Aligned Action Plan for Effective Communication of Wildland Fire Smoke Exposure Risks
Cesunica Ivey, UC Berkeley
San Francisco Bay area, CA

Enhancing Communication to Reduce Health Risks of Wildland Fire Smoke Exposure Due to Prescribed Burns
Olorunfemi Adetona, Ohio State University
OH, SC, VA

Filtration for Respiratory Exposure to wildfire Smoke from Swamp Cooler Air (FRESSCA)
Gina Solomon, Public Health Institute
Fresno and Kern counties, CA

Integrated Communication and Intervention Strategies to Reduce Exposure to Prescribed Wildland Fire Emissions in Schools, Schoolchildren and Communities
Ted Russell, Georgia Tech
Southern GA and southern AL

Participatory Design of Effective Risk Communication about Wildfire Smoke for Hard-to-Reach Populations
Linda Neuhauser, UC Berkeley
CA; Tachi Yokut Tribe, Santa Rosa Rancheria

Evaluating the Effectiveness of Interventions on Reducing Wildfire Smoke Exposure and Health Risks in Low-Income Hard-to-Reach Communities in California
Gabrielle Wong-Parodi, Stanford
San Mateo and Santa Clara counties, CA

Informing School Decision-Making during Wildfire Events: Evaluation of Indoor $PM_{2.5}$ Exposures and Associated Health Impacts in Children
Colleen Reid, CU Boulder
Denver, CO

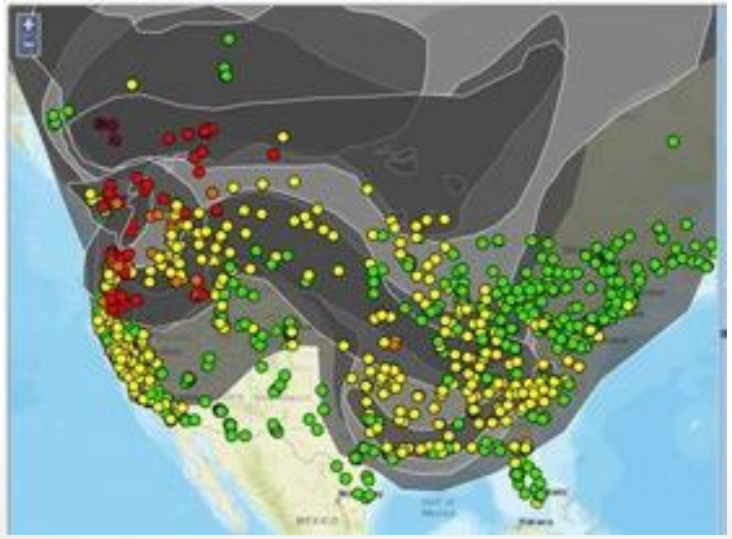
Assessing the Transport of Wildfire-Generated Particulate Matter Into Homes and Developing Practical Interventions to Reduce Human Exposure (WildPM)
Marina Vance, CU Boulder
CO or other parts of western U.S.

AIRNOW and Wildfires

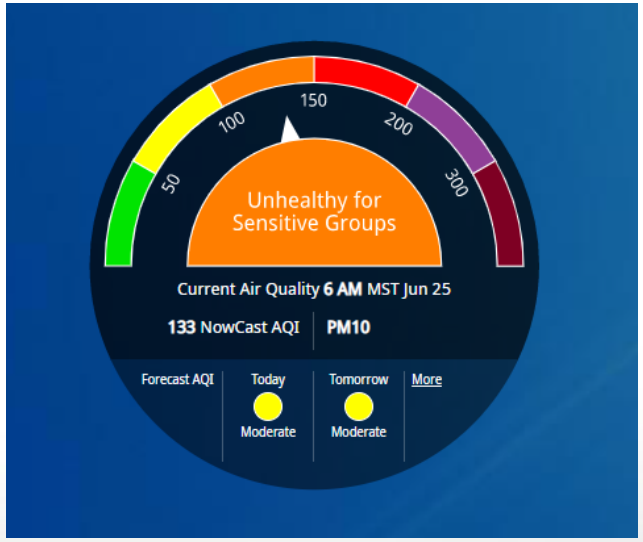
EPA's AirNow website offers nationwide daily air quality forecasts and air quality conditions for over 400 cities.

AirNow is a heavily relied-upon source of information, especially during wildfires:

- 2020 fire season saw 12 Million users (153% more than previous high during 2018 Camp Fire.)
- More than 300,000 users newly installed the AirNow phone app during that same season.
- The Fire and Smoke map was added in August 2020.



AirNow 20th Anniversary



Trusted Health and Exposure Reduction Information

Collaborate with other agencies

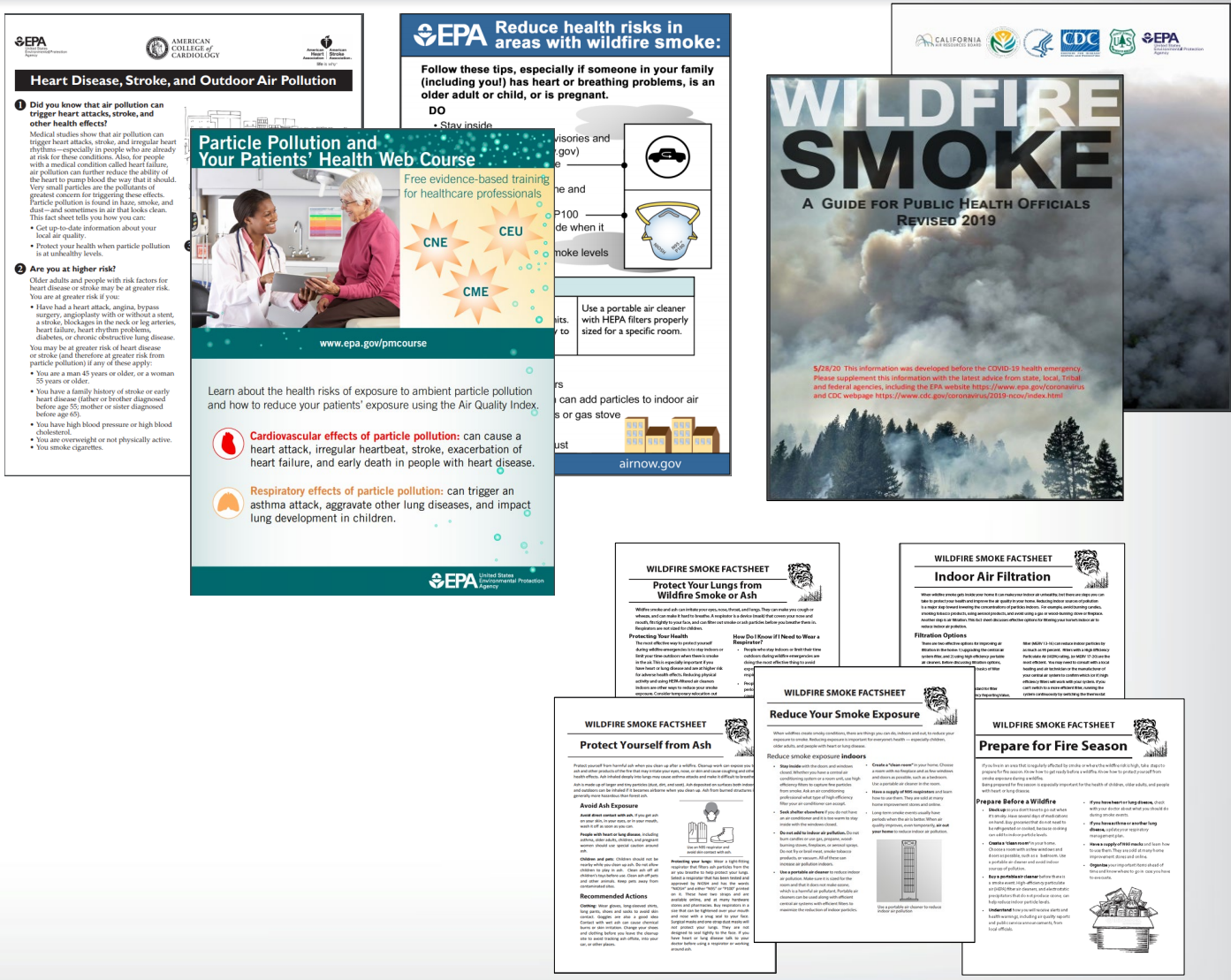
- Public wants clear and actionable messages that are consistent across all agencies
- EPA, Forest Service, CDC, CA Air Resources Board, CA Dept. of Public Health, CA Office of Environmental Health Hazard Assessment

Consistent and accurate information for all audiences

- **For different public audiences:** Factsheets, brochures and infographics
- **For health professionals:** PM Web course, Wildfire Guide and related fact sheets, targeted workshops

Looking forward

- Helping communities prepare, respond and recover
- Improve ability to advise on the ground
- More focus on at-risk populations by working with schools, medical professionals and EJ communities



Air, Climate, and Energy (ACE) Planned for FY23-FY26

Key Challenges:

- Climate Change
- Environmental and Climate Injustice
- Criteria and Toxic Air Pollution
- Wildfires
- Indoor Air Quality
- Energy and Transportation Transformations

Areas of New or Increasing Emphasis:

- Climate Change
- Exposure
- Systems Approaches
- Environmental Justice

Topic 1: UNDERSTANDING Air Pollution and Climate Change and Their Impacts on Human Health and Ecosystems

- **Research Area 1:** **Sources and Sinks** of Air Pollution and Climate Forcers
- **Research Area 2:** **Air Quality Concentrations and Exposure** Characterization: Measurements
- **Research Area 3:** **Air Quality Concentrations and Exposure** Characterization: Modeling
- **Research Area 4:** Health **Impacts** of Air Pollution and Climate Change
- **Research Area 5:** Ecosystem **Impacts** of Air Pollution and Climate Change

Topic 2: RESPONDING to Risks and Impacts and Preparing for the Future

- **Research Area 6:** Scientific Support for Climate Change and Air Quality Policy Solutions
- **Research Area 7:** Empowering communities and individuals to improve public health
- **Research Area 8:** Responding to Risks of Fires, Floods, and Other Extreme Events
- **Research Area 9:** Transitions to a Sustainable Future

Summary

- EPA research priorities resonate with Symposium theme “Health Effects of Extreme Weather and Environmental Justice: The Intersecting Peril of Planet and Its Inhabitants”
- Most of EPA’s climate research resides in Air, Climate and Energy (ACE) program. Also, one of six cross-cutting themes
- EPA has a broad and strategic climate change research portfolio that includes: wildfire smoke, GHG emissions, air quality effects, extreme precipitation, ecosystem, and public health impacts, social science considerations
- Planned FY23-26 research will build on and expand effort

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