



# **EPA Science for a Sustainable Future**

**U.S. EPA's Office of Research and Development**

**Wayne E. Cascio, MD, FAHA, FACC**

Director, Environmental Public Health Division  
National Health and Environmental Effects Research Laboratory  
Office of Research and Development, US EPA

June 19, 2014

**Wildland Fire Management Science & Technology  
Coordination Workshop**

## **Mission**

- **To protect human health and the environment**

## **Goals**

- **Address climate change and improve air quality**
- **Protect America's waters**
- **Clean up communities and advance sustainable development**
- **Ensure the safety of chemicals and prevent pollution**
- **Enforce environmental laws and ensure compliance**





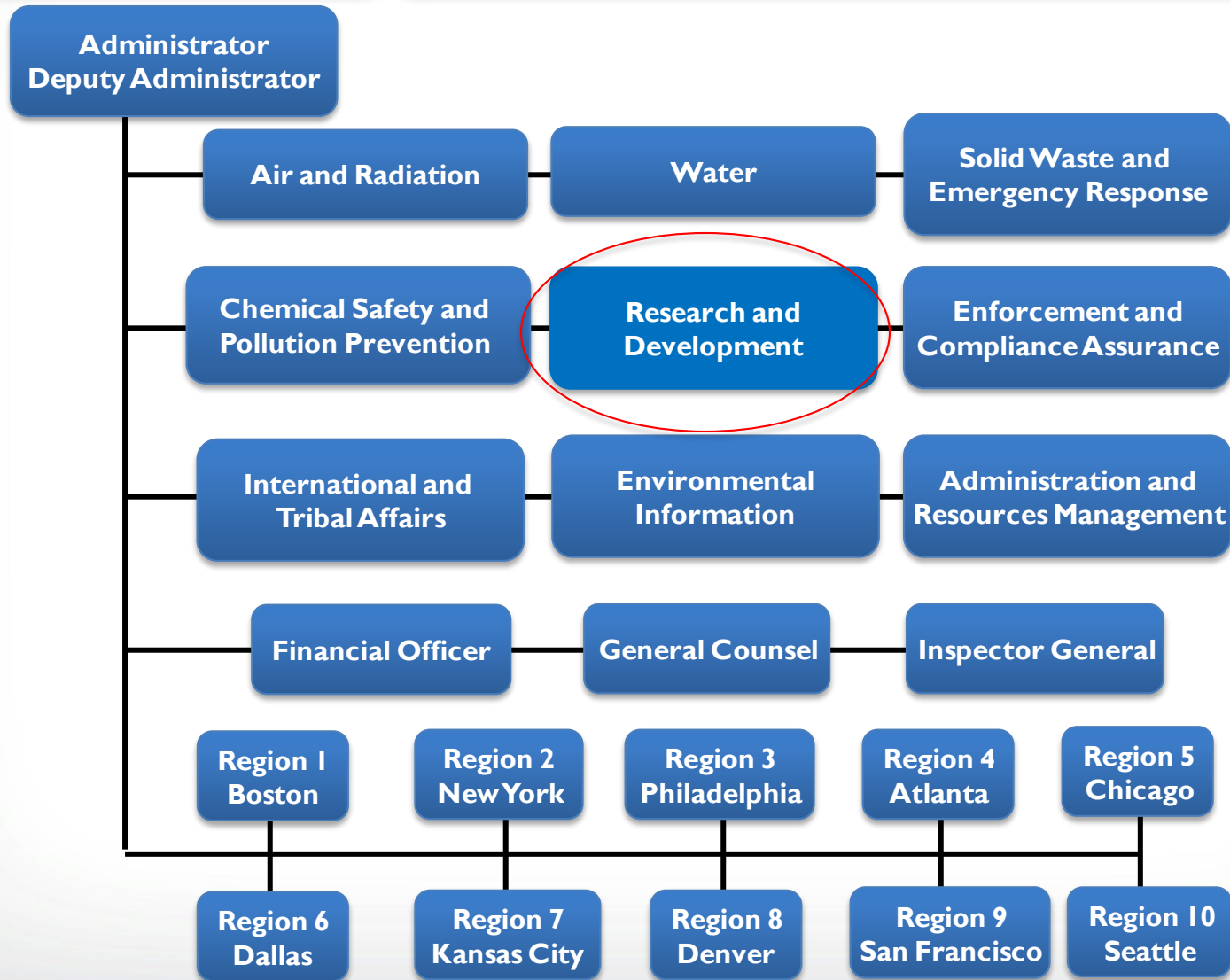
# EPA Administrator Gina McCarthy's Priorities

- **Climate change & air quality**
- **Water quality**
- **Vitality of neighborhoods**
- **Toxics & chemical safety**
- **Partnerships to spur innovation**
- **Research**





# U.S. EPA Organizational Chart





# ORD Mission

*Provide science and technology to support EPA's mission of protecting human health and the environment*

**Gulf Oil Spill**



**Bristol Bay, Alaska**





# EPA Research Supports Policy Decisions

**EPA sets standards for air pollutants** that affect public health and the environment, reviews the standards every 5 years, and supports implementation of the standards by the States.

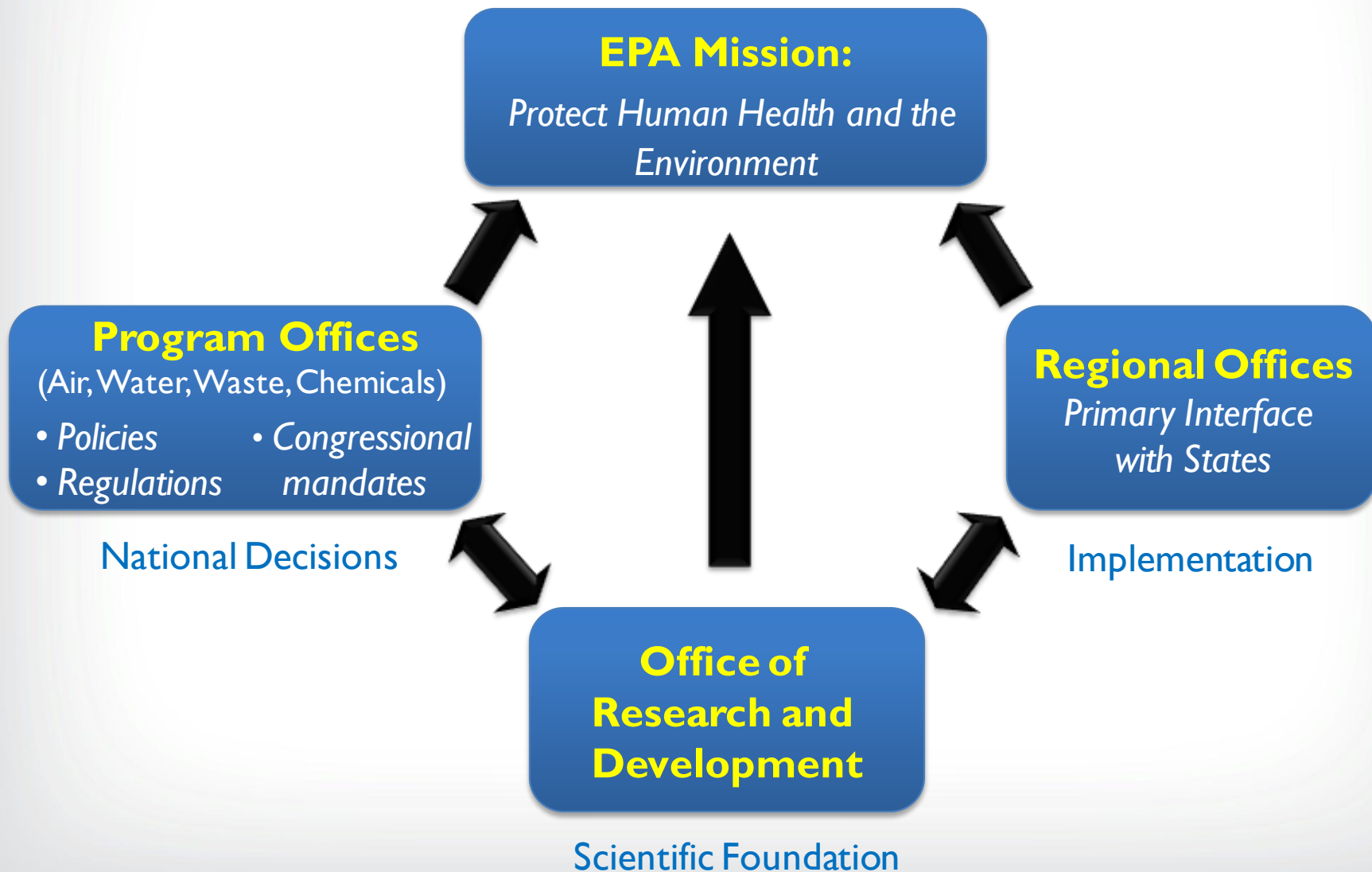
## **ORD research supports:**

- EPA's Office of Air and Radiation - in developing the standards, impacts analyses, monitoring and modeling methods
- EPA's Office of Enforcement - in developing measurement methods used to assess compliance
- States - in modeling air pollutants to evaluate most effective control strategies
- States - in air monitoring to determine compliance and identify sources contributing to air pollution.





# Science to Support EPA's Mission





# ORD Organizational Chart

**Immediate Office  
of the Assistant Administrator**

- Innovation
- Communications

Office of the  
Science Advisor

**National Program Directors**

- Air, Climate & Energy
- Safe and Sustainable Water Resources
- Sustainable and Healthy Communities
- Chemical Safety for Sustainability
- Human Health Risk Assessment
- Homeland Security

**Headquarters Offices**

- Science Policy
- Administration and Research Support
- Scientific Information and Management
- Program Accountability and Resource Management

*National Research  
Laboratories and Centers*

Health and  
Environmental  
Effects

Exposure

Risk  
Management

Environmental  
Assessment

Computational  
Toxicology

Homeland  
Security

Environmental  
Research





# Research Planning to Research Results

## Advisors and Stakeholders

EPA Programs and Regions

EPA Strategic Plan

Congressional Mandates

States, Tribes, Local governments  
Other stakeholders

External Science Advisors

Needs & Priorities

Strategic Research Action Plans

Research Priorities & Schedule

Feedback & Evaluation

Deliver Products

Conduct Research and Develop Products

Feedback



# ORD Resources at a Glance

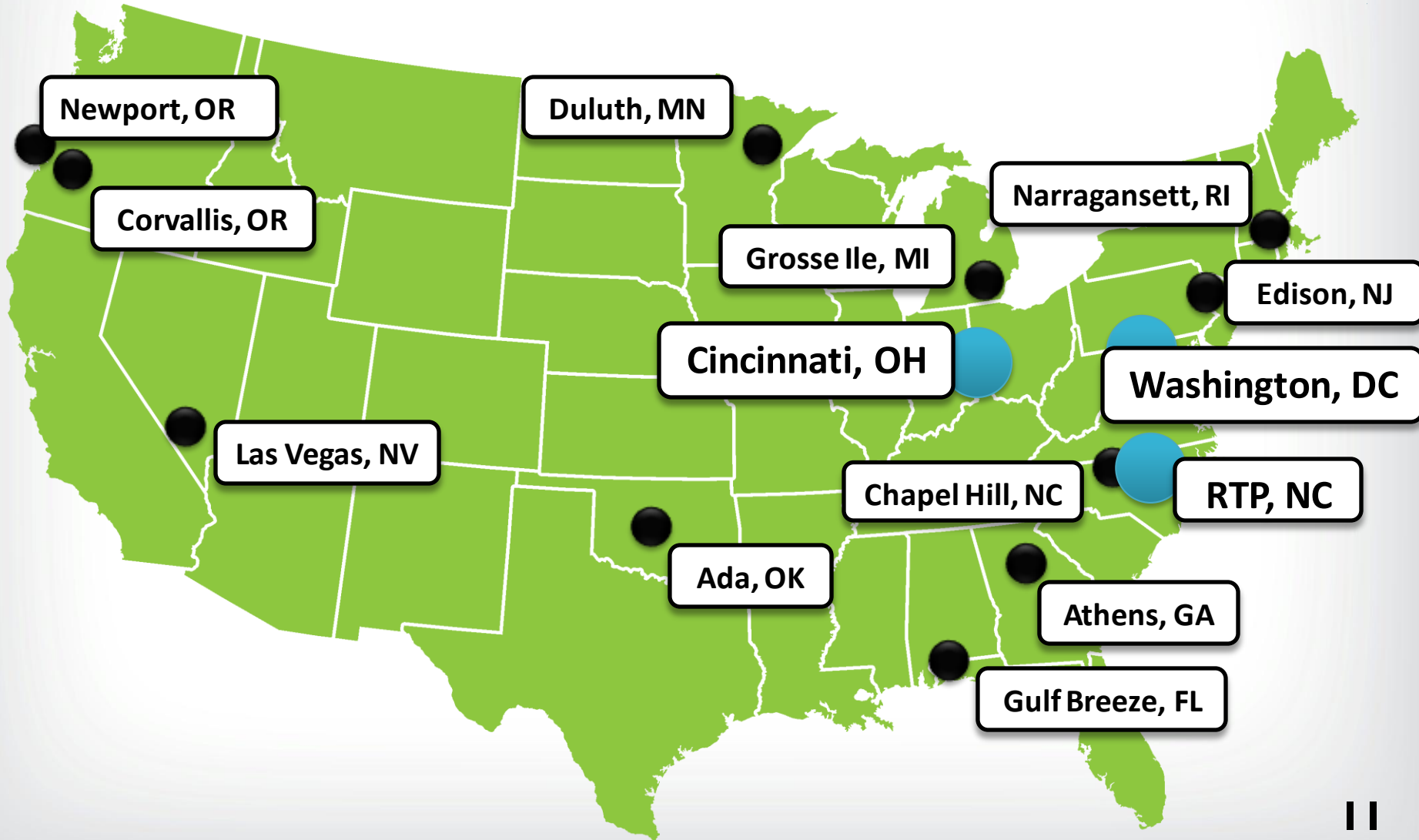
- **~1,650 FTEs**
- **\$538 million budget**
  - **\$52 million extramural research grant program (STAR)**
  - **\$9 million STAR fellowship program**
- **13 lab or research facilities**

(FY 2014 Interim Operating Plan)





# ORD Research Facilities





## Achieving our goal

- **Innovative** – foster creativity and stimulate transformational change
- **Integrative** – work collaboratively across disciplines, with other research organizations, and with stakeholders
- **Solution-Oriented** – emphasis on developing sustainable solutions
- **Responsive** – provide relevant and timely results to inform environmental policy decisions





# ORD Research Programs

**Air, Climate & Energy**



**Safe & Sustainable  
Water Resources**



**Sustainable & Healthy  
Communities**



**Chemical Safety for  
Sustainability**



**Human Health Risk  
Assessment**



**Homeland Security**



## Vision –

*Provide cutting-edge scientific information and tools to support EPA's strategic goals to protect and improve air quality and take action on climate change in a sustainable manner.*

## Research Themes –

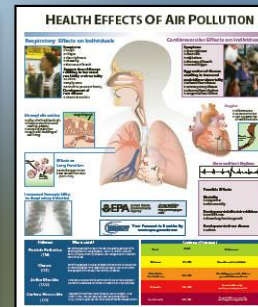
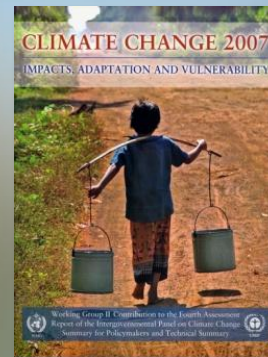
**Assess impacts** – associated with air pollutants and climate change at individual, community, regional, and global scales

**Prevent and reduce emissions** – develop and evaluate environmentally sustainable, cost effective, and innovative multipollutant and sector-based approaches

**Respond to changes in climate and air quality** – provide information needed by individuals, communities, and government agencies to adapt to the impacts of climate change and make informed public health decisions regarding air quality

## Partners –

Office of Air and Radiation  
Office of Water  
Office of Solid Waste and Emergency Response  
Office of Enforcement and Compliance Assurance  
EPA Regions



# Sustainable and Healthy Community Research Program

## Vision –

*SHC research will inform and empower decision-makers in communities - and in federal, state and tribal programs - to equitably integrate human health, ecological and economic factors into their decisions in order to achieve community sustainability.*

## Research Themes –

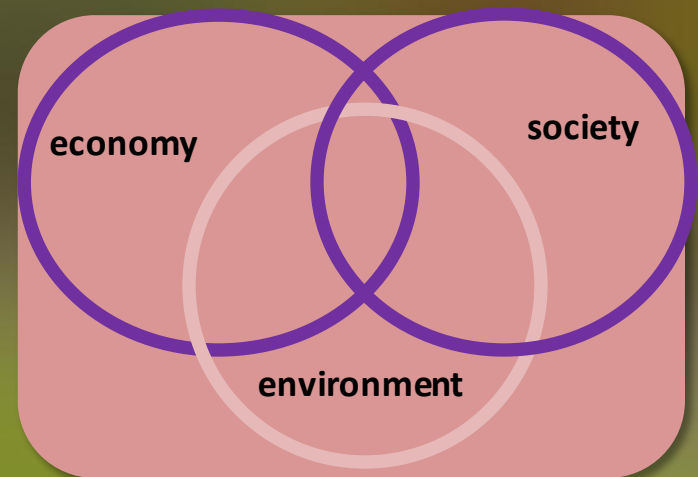
**Provides** methods and tools to fully account for the environmental, social and economic costs and benefits of alternative policy and management decisions, and tradeoffs among them.

**Develops** innovative approaches for communities to access and share data and analyses.

**Improves** protection of human health and the environment by evaluating sustainable provision of ecosystem services and the ways that human well being is affected by the natural and built environment.

## Partners –

Office of Solid Waste and Emergency Response  
EPA Regions  
Office of Air and Radiation  
Office of Water  
Office of Children's Health  
Office of Sustainable Communities  
Office of Environmental Justice



# Safe and Sustainable Water Resources Research Program

## Vision –

*An integrated, systems approach to research for the identification and development of the scientific, technological and behavioral innovations needed to ensure clean, adequate and equitable supplies of water that support human well-being and resilient aquatic ecosystems*

## Research Themes –

### Sustainable Water Resources

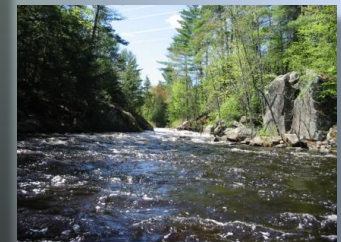
Ensure safe and sustainable water quality and availability; protect human and ecosystem health; protect and restore water resources

### Sustainable Water Infrastructure

Ensure sustainability of critical water resources; integrated water resource management; safe, high quality drinking water; transport and treatment of wastewater and stormwater

## Partners –

EPA Program Offices and Regions, USGS, USFWS, NOAA, USDA, DoD, DoE, states, tribes, universities, NGOs, international community



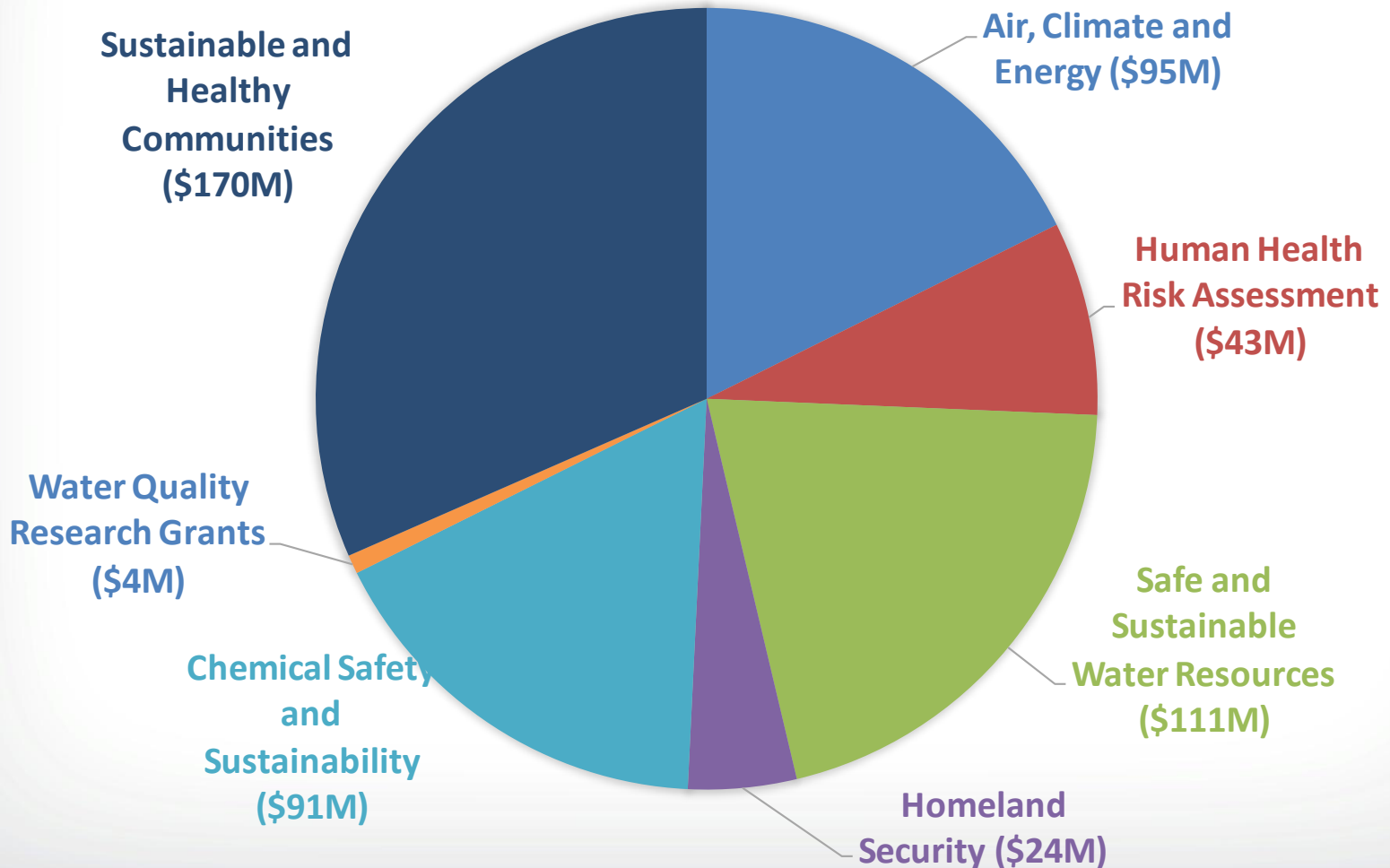
<http://www.epa.gov/ord/priorities/waterresources.htm>





# ORD Budget by Research Program

2014 FUNDING (\$ MILLIONS)\*





# Air, Climate, & Energy

- **Assess impacts of air pollution and climate change**
- **Prevent and reduce emissions**
- **Respond to changes in climate and air quality**



**Dan Costa**  
**National Program**  
**Director**





# EPA Research Integrated Across Laboratories

**Multiple ORD Labs and centers conduct an integrated air pollution research program**

- Research Triangle Park
- Chapel Hill
- Corvallis
- Washington, DC
- NCER grantees across the U.S



**Human health study in Chapel Hill**



**Outdoor chambers for ecosystem impact studies in Corvallis**



**Emission measurement and methods in Research Triangle Park**



**Evaluating regulatory monitors and new air sensors in Research Triangle Park**





## Environmental Public Health Division Human Studies Facility, Chapel Hill, NC

The Environmental Public Health Division performs epidemiological, clinical, and animal toxicology research in support of the assessment of risk and public health outcomes.



76 EPA Staff, 55% with Ph.D.'s

- 70 Scientists
- 6 Administrative Support  
(4 Pulmonologists, 1 Cardiologist, 2 Veterinarians, 4 RNs, & 12 Engineers)

8 environmental chambers

On-site engineering contractor and human study recruiting contractor

Capacity to do controlled human exposure studies (various fractions of PM, dilute diesel exhaust, woodsmoke, and gases)

### Current Research Topics

- Evaluates the impact of environmental exposures on human health by developing and validating biomarkers of exposure and effects
- Conducts population-based and human clinical studies and parallel animal and *in vitro* and *in vivo* toxicology studies
- Assesses the impact of environmental actions and decisions on public health outcome





# Grand Challenges

## **Grand Challenge #1**

*Provide hazard and disaster information where and when it is needed*

## **Grand Challenge #3**

*Develop hazard mitigation strategies and technologies*

## **Grand Challenge #4**

*Assess disaster resilience*

## Wildfire Smoke

A Guide for Public Health Officials



- The 2008 Wildfire Smoke Guide is being up-dated by a team including members from US Forest Service, CDC and US EPA.
  - *Provides guidance for public health officials and is available on-line for public education*
- Published CME course for health care providers on health effects of ozone
- Near completion of a CME course for health care professionals for health effects of PM



# Communicating Wildfire Smoke Advisories and Forecasts

The screenshot shows the AirNow website interface. At the top left is the AirNow logo. To its right is a search bar for "Local Air Quality Conditions" with fields for "Zip Code" and "State" (set to "Alabama"), and "Go" buttons. Further right is a "National Summary" link. Below the search bar are navigation tabs: "Forecast", "Current AQI", "AQI Loop", and "More Maps". The main content area features a map titled "Today's AQI Forecast" for "Saturday, June 14, 2014". The map shows the United States with various colored regions indicating AQI levels. A red circle highlights a sidebar on the right titled "Wildfire Smoke Advisories and Forecasts". Inside this sidebar, there is a link "For more information" and a section "Announcements" with several news items: "6/2/14: Congratulations to the 2014 EnviroFlash Challenge Winners.", "5/30/14: Check out AirNow's new Ozone Facts page.", "5/15/14: Check out AirNow's updated Weathercaster page.", and "5/1/14: A Look Back: Ozone 2013". A yellow arrow points to the "Announcements" section. Below the announcements is a "more announcements" link. At the bottom of the sidebar are sections for "Air Quality Basics" (with links for Air Quality Index, Ozone, Particle Pollution, UV, Smoke from fires, and What You Can Do), "Health", and "Learning Center".



# Communicating Preparation for Wildfire Smoke

## Natural Disasters

### Natural Disasters Home

You are here: EPA Home » Natural Disasters » Wildfires

### Basic Information

## Wildfires



### Drought

Always call 911 if you are in immediate danger and need emergency help.

### Earthquakes

en español

### Extreme heat

- Prepare for or respond to a wildfire – understand the dangers and what you can do when wildfire is predicted or advancing.
- Recover after a wildfire – what you can do to protect your family, home from related hazards; also information for businesses and communities.

### Flooding

Many of the links below go to sites outside EPA. [EXIT Disclaimer](#)

### Hurricanes

## Prepare for or respond to a wildfire

### Snow & Ice

### Air quality health information:

### Tornadoes

- Current air quality forecast (Ozone and particulates) – click on your area
- Sign up to receive air quality email notices for your ZIP code
- Read more: How Smoke from Fires Can Affect Your Health
- Asthma triggers and outdoor air pollution
- Interagency Real Time Smoke particulate Monitoring, from USDA

### Tsunamis

### Volcanoes

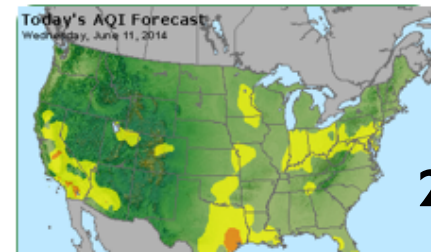
### Wildfires

### General Preparedness Information

### Desastres naturales & emergencias climáticas



Photo from FEMA / Bryan Dahlberg







# Communicating Risk for Wildfires



## It All Starts with Science

AN EPA BLOG ABOUT SCIENCE MATTERS

Search this blog...

[Home](#) [About](#) [Comment Policy](#) [Other Greenversations](#)



## Climate Change and Wildfires: What's the Connection?

2013 AUGUST 21

By *Krystnell A. Storr*

For me, fire comes from the end of a match or the flick of a lighter—a controllable little ball of fury the size of a fingertip. For others, it is the transformation of the towering pine trees that surround homes and roadways into a horde of fiery giants. Its march, dangerous and unruly, has made one thing very



Share

572 people like this. Sign Up to see what your



SUBSCRIBE TO THIS BLOG

Enter e-mail address

Go

FOLLOW ALL EPA BLOGS



MORE WAYS TO CONNECT WITH EPA

### RECENT POSTS

- > [When Green Goes Bad](#)
- > [A New Frontier for Air Sensors 2014](#)
- > [Bringing EPA Research—and Confidence—to the Classroom](#)
- > [How Did You Celebrate Earth Day?](#) **25**



# Sustainable & Healthy Communities



United States Environmental Protection Agency

[Advanced Search](#)

[A-Z Index](#)

[LEARN THE ISSUES](#)

[SCIENCE & TECHNOLOGY](#)

[LAWS & REGULATIONS](#)

[ABOUT EPA](#)

SEARCH

## 2012 EPA Research Progress Report

[Contact Us](#) [Share](#)

**You are here:** [EPA Home](#) » [Research](#) » [2012 EPA Research Progress Report](#) » [Sustainable and Healthy Communities](#)  
» [Studying the Connections between Wildfire Smoke and Community Health](#)

## Studying the Connections between Wildfire Smoke and Community Health

More than 73,000 wildfires broke out in the United States in 2011, and that figure is expected to rise with climate change. Results from a new EPA study will help state agencies and the EPA Office of Air and Radiation identify and assist vulnerable communities and individuals who are highly susceptible to air pollutants—especially those released by wildfires.

Researchers compared different health factors in counties in eastern North Carolina that were exposed to smoke from a 2008 peat wildfire in Pocosin Lakes National Wildlife Refuge. The peer-reviewed study shows that poorer residents had a much higher chance of getting sick from air pollutants caused by the wildfire.

During the fire, burning deposits of partially decayed vegetation released smoke and haze for several weeks. One particularly bad episode left dense ground-level smoke covering most of the eastern and central parts of the state for approximately three days. Researchers found that during this time, significantly more people than usual visited hospital emergency rooms for heart and lung complications linked to wildfire smoke inhalation.



Satellite imaging shows a smoke plume from the 2008 North Carolina peat fire



# Wildfire Smoke & Health



Stilted trees, resulting from deep peat fire

- Evans Road Fire on Pocosin Lakes National Wildlife Refuge
- Initiated by lightning strike on June 1, 2008
- Burned 40,704 acres
- 60% of the acreage was refuge property and the remainder State or private land
- Countless tons of peat were consumed by the fire
- Suppression efforts cost approx \$20 million



# Wildfire Smoke & Health


- Satellite data and syndromic surveillance were combined to assess the health impacts of wildfire smoke in rural counties with sparse air-quality monitoring. This is the first study to show both lung and cardiac effects after brief exposure to peat wildfire smoke.

Research

**Peat Bog Wildfire Smoke Exposure in Rural North Carolina Is Associated with Cardiopulmonary Emergency Department Visits Assessed through Syndromic Surveillance**

*Ana G. Rappold,<sup>1</sup> Susan L. Stone,<sup>1</sup> Wayne E. Cascio,<sup>1</sup> Lucas M. Neas,<sup>1</sup> Vasu J. Kilaru,<sup>2</sup> Martha Sue Carraway,<sup>1</sup> James J. Szykman,<sup>3</sup> Amy Ising,<sup>4</sup> William E. Cleve,<sup>5</sup> John T. Meredith,<sup>6</sup> Heather Vaughan-Batten,<sup>7</sup> Lana Deyneka,<sup>7</sup> and Robert B. Devlin<sup>1</sup>*

Rappold et al. *Environmental Health* 2012, 11:71  
<http://www.ehjournal.net/content/11/1/71>

 ENVIRONMENTAL HEALTH

**RESEARCH** **Open Access**

Cardio-respiratory outcomes associated with exposure to wildfire smoke are modified by measures of community health

Ana G Rappold<sup>1\*</sup>, Wayne E Cascio<sup>1</sup>, Vasu J Kilaru<sup>2</sup>, Susan L Stone<sup>3</sup>, Lucas M Neas<sup>1</sup>, Robert B Devlin<sup>1</sup> and David Diaz-Sanchez<sup>1</sup>

**Estimating Health Burden from Smoke Exposure During Peat Wildfire in North Carolina**

Ana G. Rappold PhD<sup>1</sup>, Neal L. Fann MPP<sup>2</sup>, James Crooks PhD<sup>1</sup>, Jin Huang<sup>3</sup>, Wayne E. Cascio MD<sup>1</sup>, Robert B. Devlin PhD<sup>1</sup>, David Diaz-Sanchez PhD<sup>1</sup>

- Study suggests that forecasting might be used to mitigate smoke-related health care utilization and social costs (in review).

- SES factors at the county level modified risk of health effects air pollution exposure.



# Progress on Health Effects of Wildland Fire

Over the past three years EPA has shown that peat wildfires in 2008 in eastern NC were associated with:

- Excess ED visits for asthma and other respiratory diseases, and heart failure
- Risk was related to poverty
- Cost were substantial
- Animal toxicology studies showed that the respiratory system was more sensitive to the coarse PM fraction and the CV system was more sensitive to the ultrafine fraction



EPA is modeling the cost-benefit of public health notification for various increases in wildfire smoke based on the health effects associated with the 2008 peat wildfires in NC



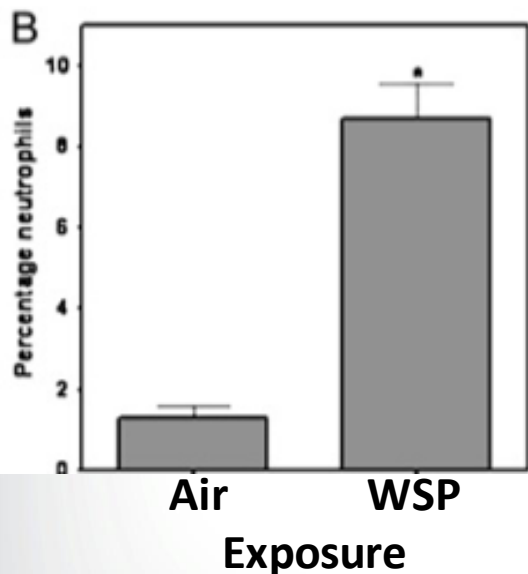
# Controlled Exposure Studies Wood smoke

ORIGINAL ARTICLE

## Exposure to wood smoke particles produces inflammation in healthy volunteers

Andrew J Ghio,<sup>1</sup> Joleen M Soukup,<sup>1</sup> Martin Case,<sup>1</sup> Lisa A Dailey,<sup>1</sup> Judy Richards,<sup>1</sup> Jon Berntsen,<sup>2</sup> Robert B Devlin,<sup>1</sup> Susan Stone,<sup>1</sup> Ana Rappold<sup>1</sup>

*Occup Environ Med* 2012;**69**:170–175. doi:10.1136/oem.2011.065276



- 10 healthy individuals (ages 18 to 40 years). PM<sub>2.5</sub>, 485±84 µg/m<sup>3</sup> for 2 hrs with intermittent exercise.
- % Neutrophils in bronchoalveolar lavage after Air or Woodsmoke (red oak) relative to air exposure.



*Ambient PM Concentrator  
EPA Human Studies Facility  
Chapel Hill, NC*

Conclusions: human exposure to WSP may be associated with evidence of both systemic and pulmonary inflammation.



# Controlled Exposure Studies

## *Concentrated ambient air particles*

### Research

## **Omega-3 Fatty Acid Supplementation Appears to Attenuate Particulate Air Pollution–Induced Cardiac Effects and Lipid Changes in Healthy Middle-Aged Adults**

*Haiyan Tong,<sup>1</sup> Ana G. Rappold,<sup>1</sup> David Diaz-Sanchez,<sup>1</sup> Susan E. Steck,<sup>2</sup> Jon Berntsen,<sup>3</sup> Wayne E. Cascio,<sup>1</sup> Robert B. Devlin,<sup>1</sup> and James M. Samet<sup>1</sup>*

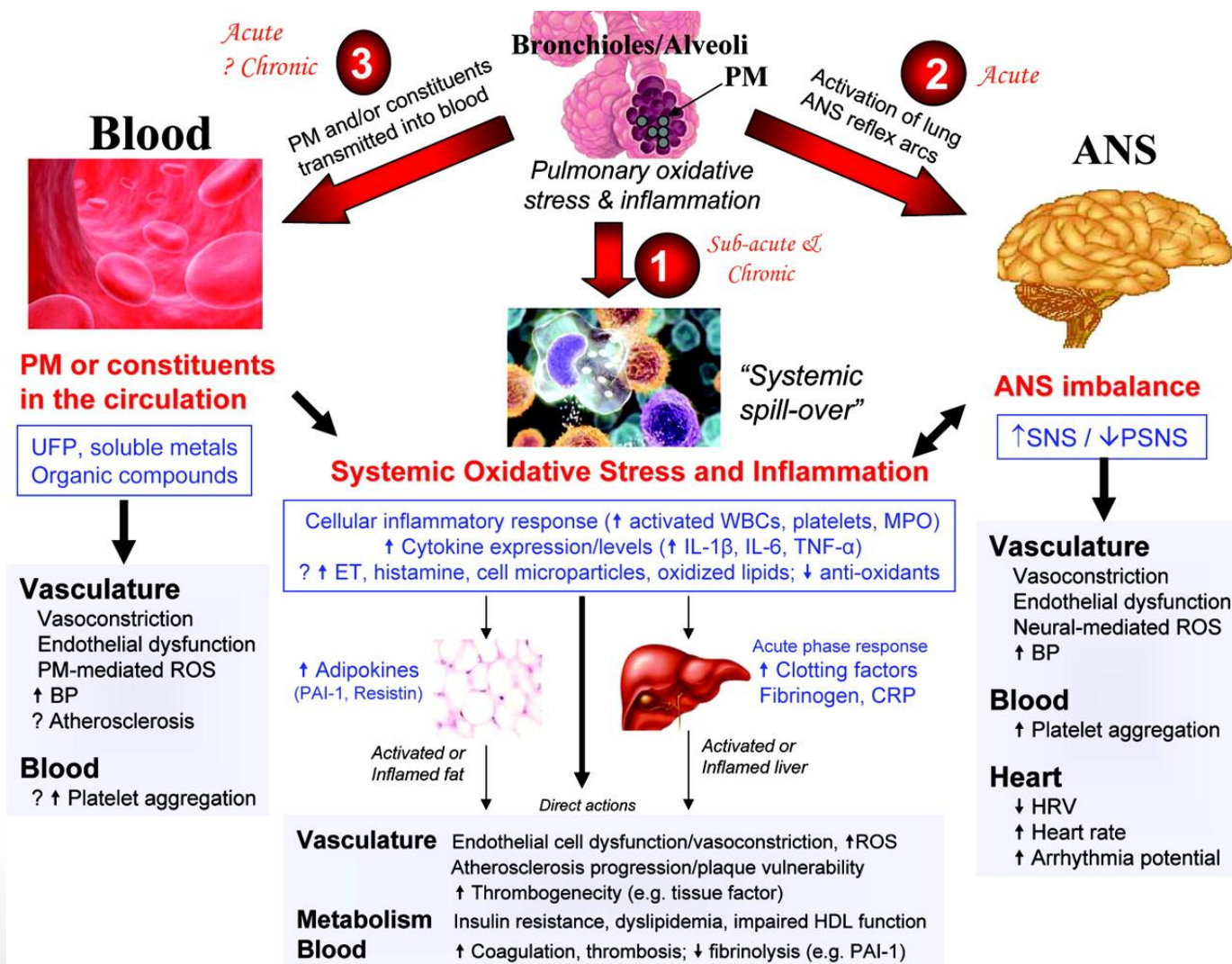
<sup>1</sup>Environmental Public Health Division, National Health and Environmental Effects Research Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, USA; <sup>2</sup>Department of Epidemiology and Biostatistics, University of South Carolina, Columbia, South Carolina, USA; <sup>3</sup>TRC Environmental Corporation, Raleigh, North Carolina, USA

Environmental Health Perspectives 120:952, 2012

Exposure of healthy middle-aged adults to Concentrated Ambient Air Particles (CAPs) for 2 hr induced acute cardiac and lipid changes after supplementation with olive oil, but not fish oil.

Findings suggest that omega-3 fatty acid supplementation offers protection against the adverse cardiac and lipid effects associated with air pollution exposure.

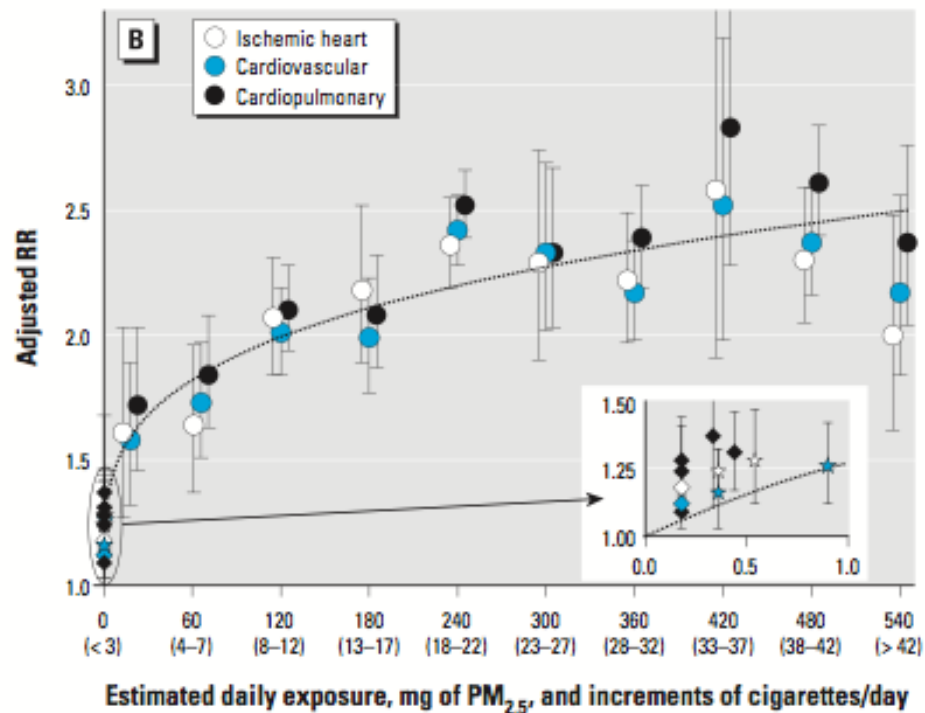
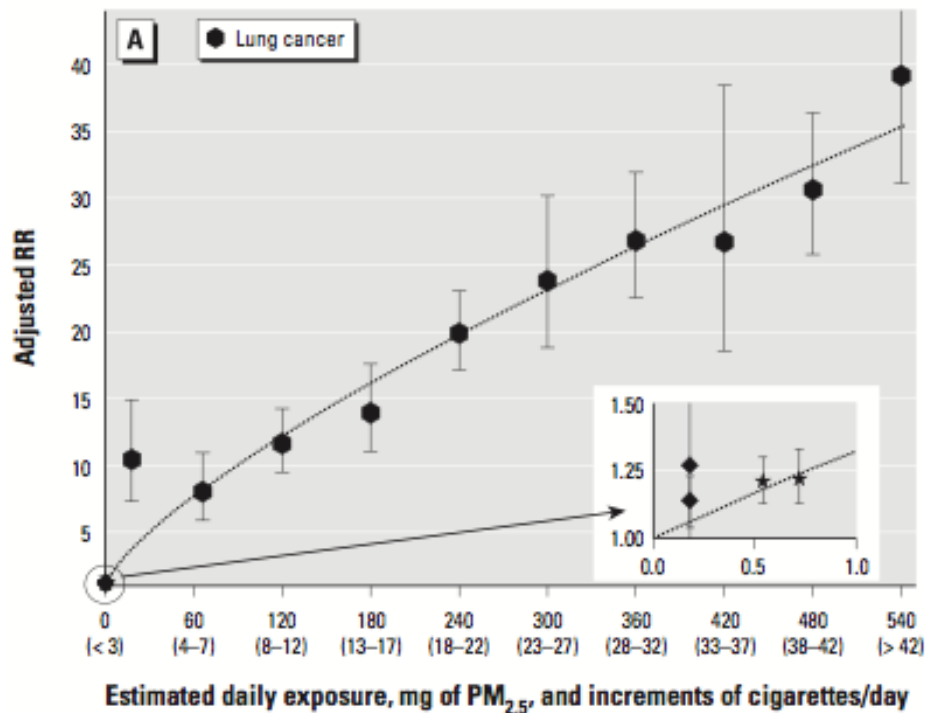
# Biological Pathways Linking PM exposure to CVD







# Estimated PM-Dose Relationship to Long-term Health Effects

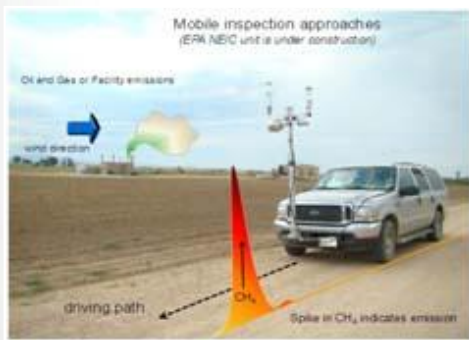


Pope CA 3rd, Burnett RT, Turner MC, Cohen A, Krewski D, Jerrett M, Gapstur SM, Thun MJ. Environ Health Perspect. 2011;119:1616-21



# Next Generation Air Monitoring

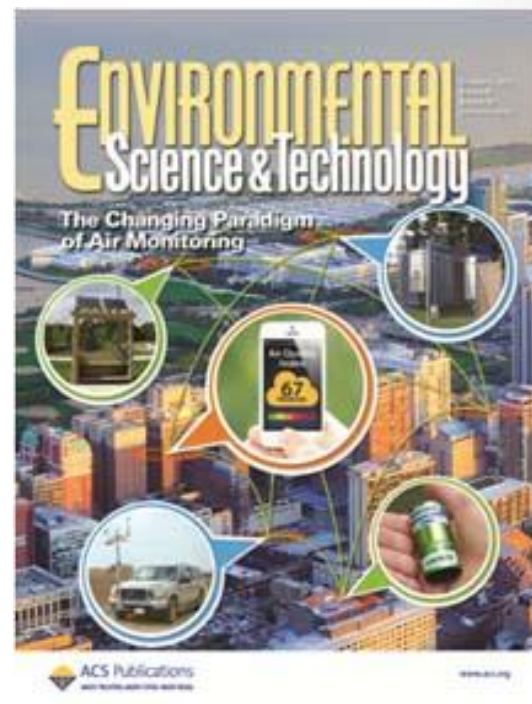
- Developing and stimulating new technology
- New innovations in facility fence-line monitoring
- Evaluating emerging sensor technology
- Promoting community participation in air monitoring
- Satellite-based air quality measurements



*Mobile monitoring for geospatial mapping of pollutants (GMAP)*



*“Village Green” park bench monitors air quality*



**My Air  
My Health**

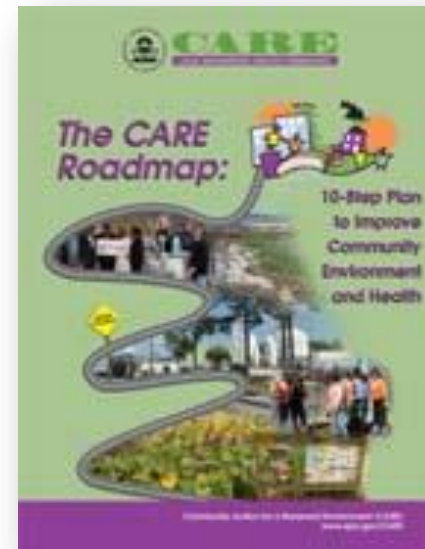
U.S. Department of Health and Human Services  
U.S. Environmental Protection Agency



# Promoting Sustainable Communities

## Facilitating Community and Tribal Decision-making

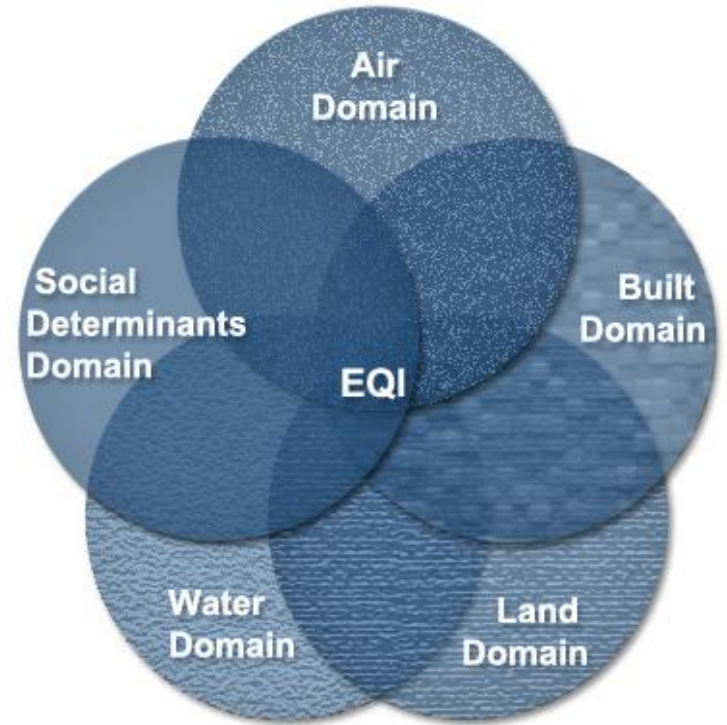
- Web-based “toolkits” providing easier access to information for more than 40 environmental issues
- Mapping local exposures, health risks, and potentially vulnerable sites and populations



Calculate an environmental quality index (EQI) for all counties in the U.S. taking into account:

- five domains: air, water, land, built environment, and SES that influence exposure and health
- incorporates data representing the chemical, natural and built environment

Principles of sustainability are not inherent in the estimates



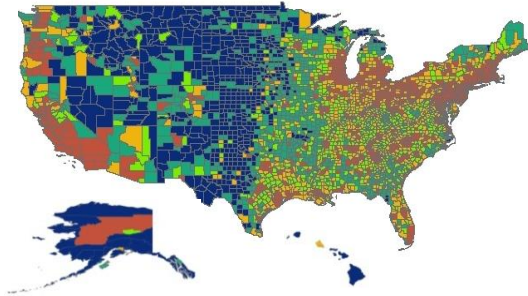
**EQI can be a valuable parameter to measure progress towards attainment of sustainability**



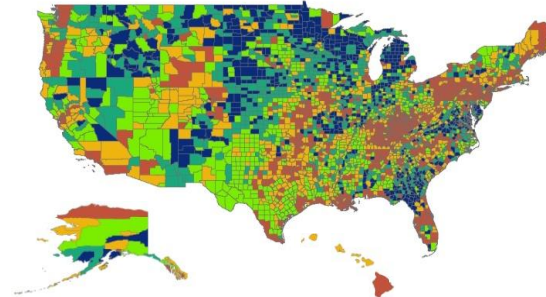
## Data Sources by Domain

<b>DOMAIN</b>	<b>DATA SOURCES</b>
Air	Air Quality System (AQS); National Air Toxics Assessment (NATA)
Land	County pesticide use estimates; 2002 Census of Agriculture Full Report; Dun and Bradstreet Agriculture Data; Web Feature Service for National Priority List (NPL) Sites; National Geochemical Survey (NGS); Map of Radon Zones
Water	National Water Information System (NWIS); STORET; WATERS Program/Reach Address Databases; National Contaminant Occurrence Database (NCOD); Safe Drinking Water Information System (SDWIS); Estimates of Water Use in U.S.; Drought Monitor Data; National Atmospheric Deposition Program; Nutrient Loss Database for Agricultural Fields in U.S.
Built Environment	Duns and Bradstreet North American Industry Classification System (NAICS) codes; Topologically Integrated Geographic Encoding and Referencing (TIGER); Rural-Urban Commuting Area (RUCA) Codes; Fatality Annual Reporting System
Socio-demographic	Uniform crime reports; U.S. Census; Home Mortgage Disclosure Act (HDMA) Data

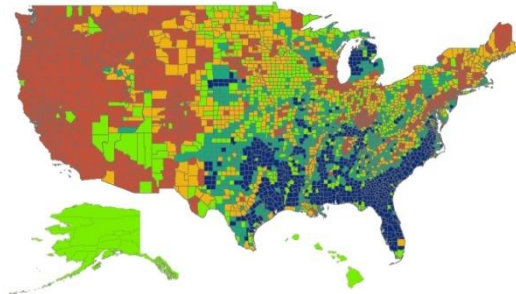
Air



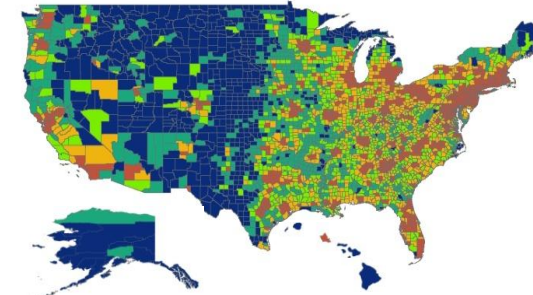
Water



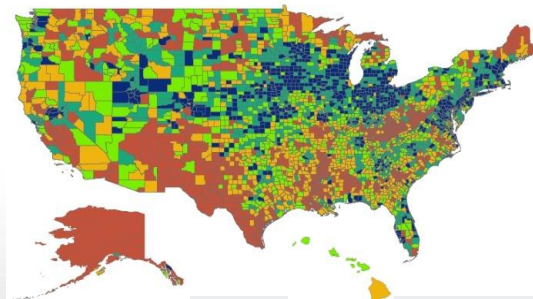
Land



Built Environment



Sociodemographic



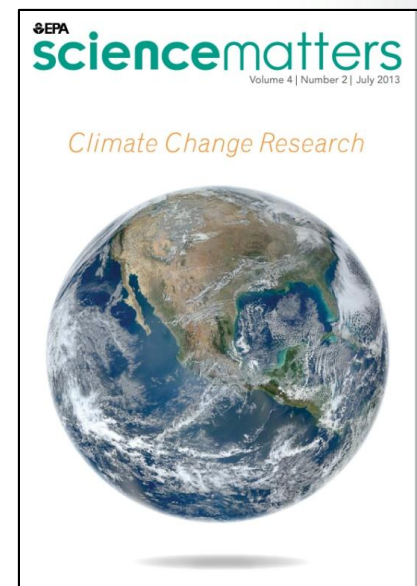
**Index category**

- Min - <20%
- 20 - <40%
- 40 - <60%
- 60 - <80%
- 80 - Max



# Communicating EPA Research Impacts

- **EPA Science Matters newsletter: electronic & print** <http://epa.gov/sciencematters/>
- **EPA research Twitter account:** <http://twitter.com/EPAresearch>
- **It All Starts With Science Blog:** <http://blog.epa.gov/science/>
- **EPA Research page:** [www.epa.gov/research](http://www.epa.gov/research)
- **Targeted Outreach Campaigns, e.g.,**



- Stormwater Calculator

- 
- 





**Questions?**



## ***Cross-cutting Research Example***

- **Coordinating with other federal agencies through US Global Change Research Program**
- **Adaptation research includes:**
  - Extreme weather events
  - Climate-resilient investment by communities
  - Health of forests and potential as a carbon sink
- **ORD research also addresses:**
  - Environmental impacts of control strategies for greenhouse gases
  - Environmental impacts of changes in how energy is produced and used (e.g. hydraulic fracturing)
  - Potential for reducing emissions from cookstoves





# Climate Change & Air Quality

## The GLIMPSE Integrated Framework

- **GLIMPSE modeling to simultaneously evaluate air quality, ecosystem conservation, and climate change goals**
- **Wildfire increases predicted**
  - Length of fire season will increase by 3 weeks by 2050, with significant increase in PM pollution (STAR grant)
- **Greater health benefits of greenhouse gas mitigation**
  - Valued at \$50-\$380 per ton of CO<sub>2</sub>, much higher than previously thought (STAR grant)

