Applications of Earth Science Research for the National Environmental Public Health Tracking Program

Health and Air Quality Applications Program Review, September, 2018

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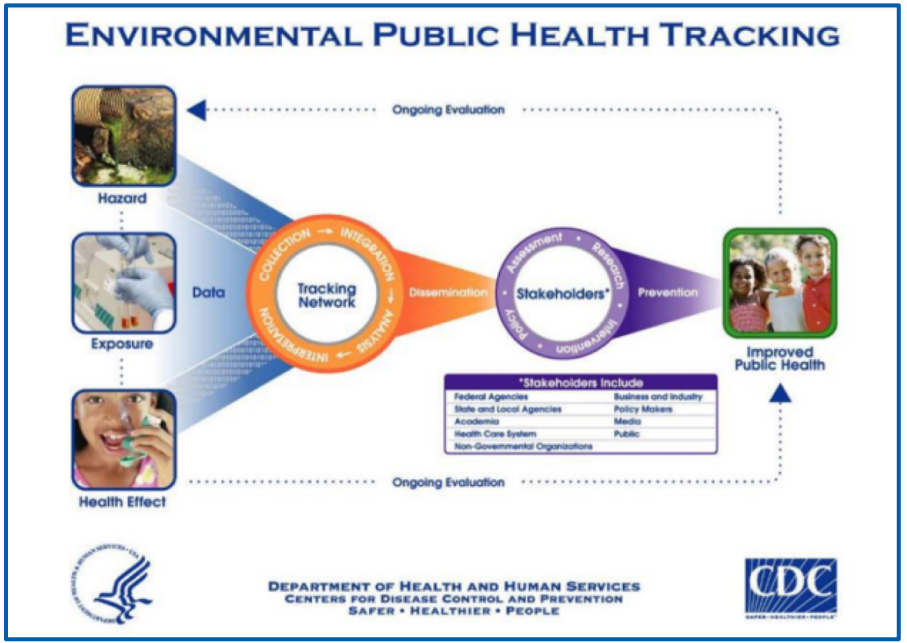
Division of Environmental Health Science and Practice

National Environmental Public Health Tracking Program

Vision: Healthy informed communities

Mission: To provide information from a nationwide network of integrated health and environmental data that drives actions to improve the health of communities

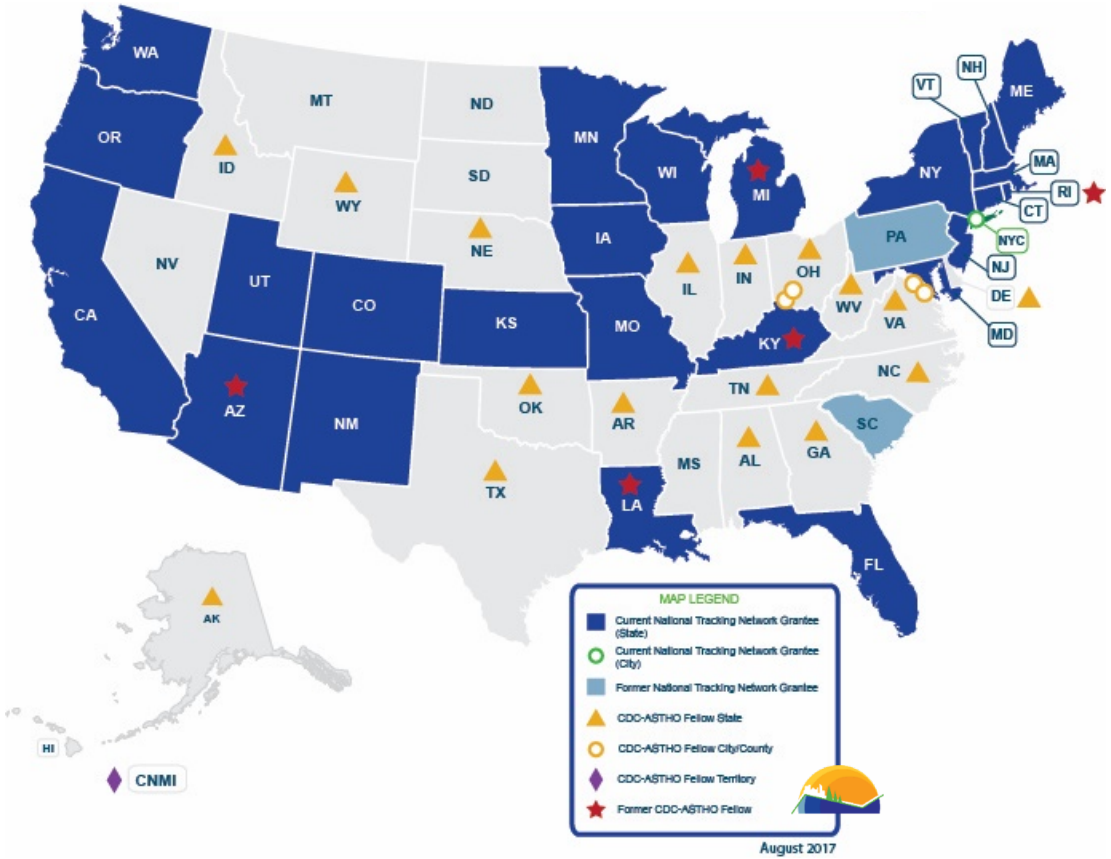


The Tracking Program

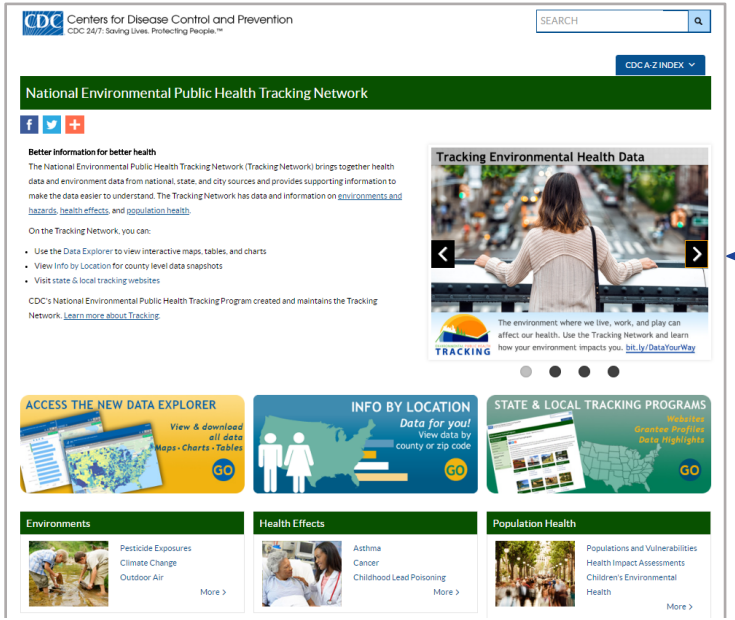
26
Grantees
25 states / 1 city

41
CDC-ASTHO Fellowships
Since 2009

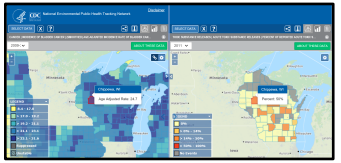
25+
Partnerships
With CDC Programs, Other Federal Agencies, National Organizations



National Environmental Public Health Tracking Network

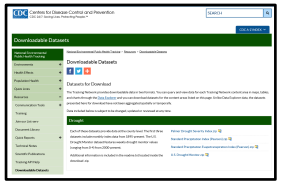


www.cdc.gov/ephtracking



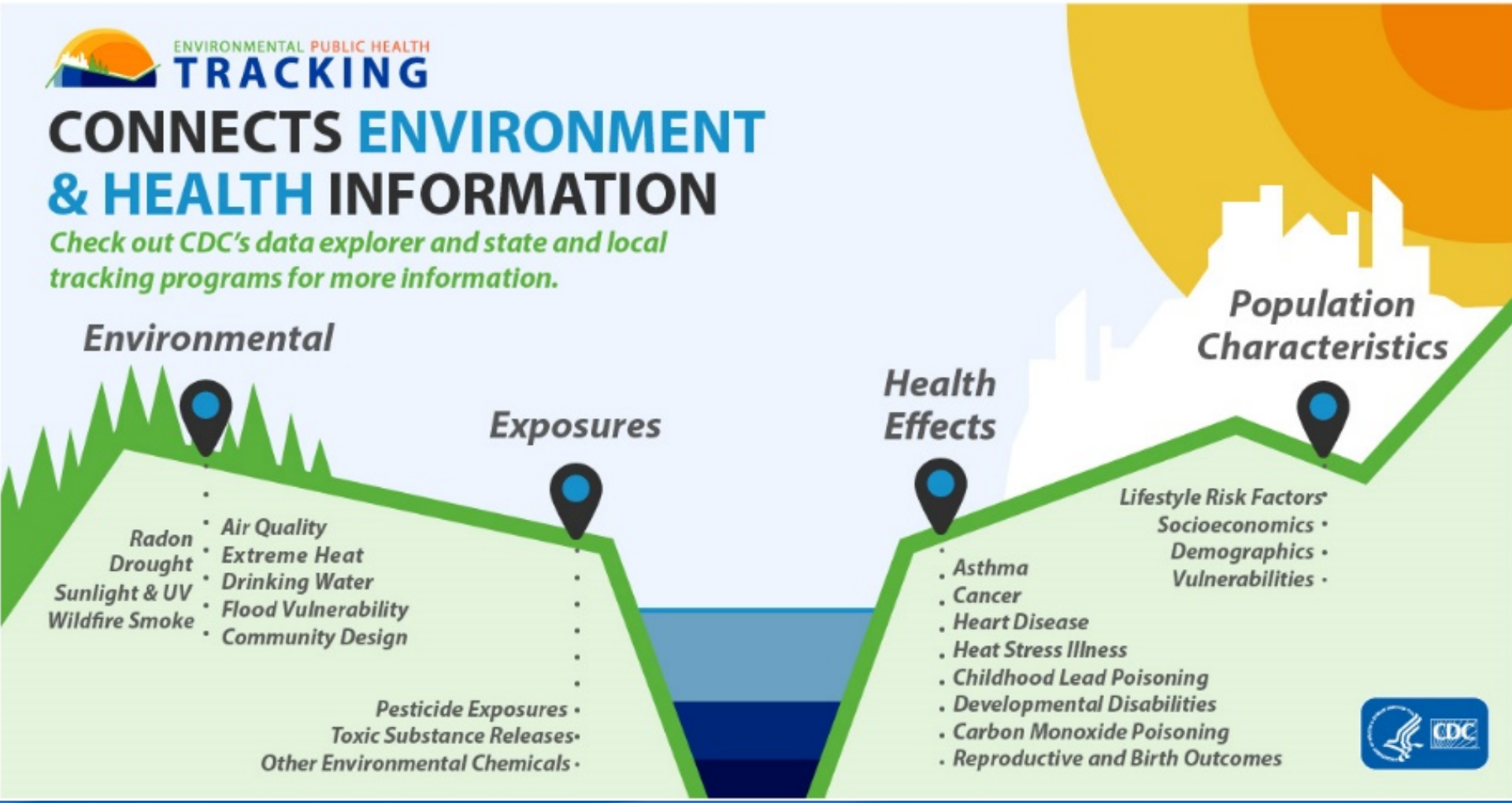
Data Explorer

Info by Location



Downloadable Datasets

Application Program Interface


ENVIRONMENTAL PUBLIC HEALTH TRACKING
CONNECTS ENVIRONMENT & HEALTH INFORMATION
Check out CDC's data explorer and state and local tracking programs for more information.
Environmental
Exposures
Health Effects
Population Characteristics
Radon
Drought
Sunlight & UV
Wildfire Smoke
Air Quality
Extreme Heat
Drinking Water
Flood Vulnerability
Community Design
Pesticide Exposures
Toxic Substance Releases
Other Environmental Chemicals
Asthma
Cancer
Heart Disease
Heat Stress Illness
Childhood Lead Poisoning
Developmental Disabilities
Carbon Monoxide Poisoning
Reproductive and Birth Outcomes
Lifestyle Risk Factors
Socioeconomics
Demographics
Vulnerabilities
CDC

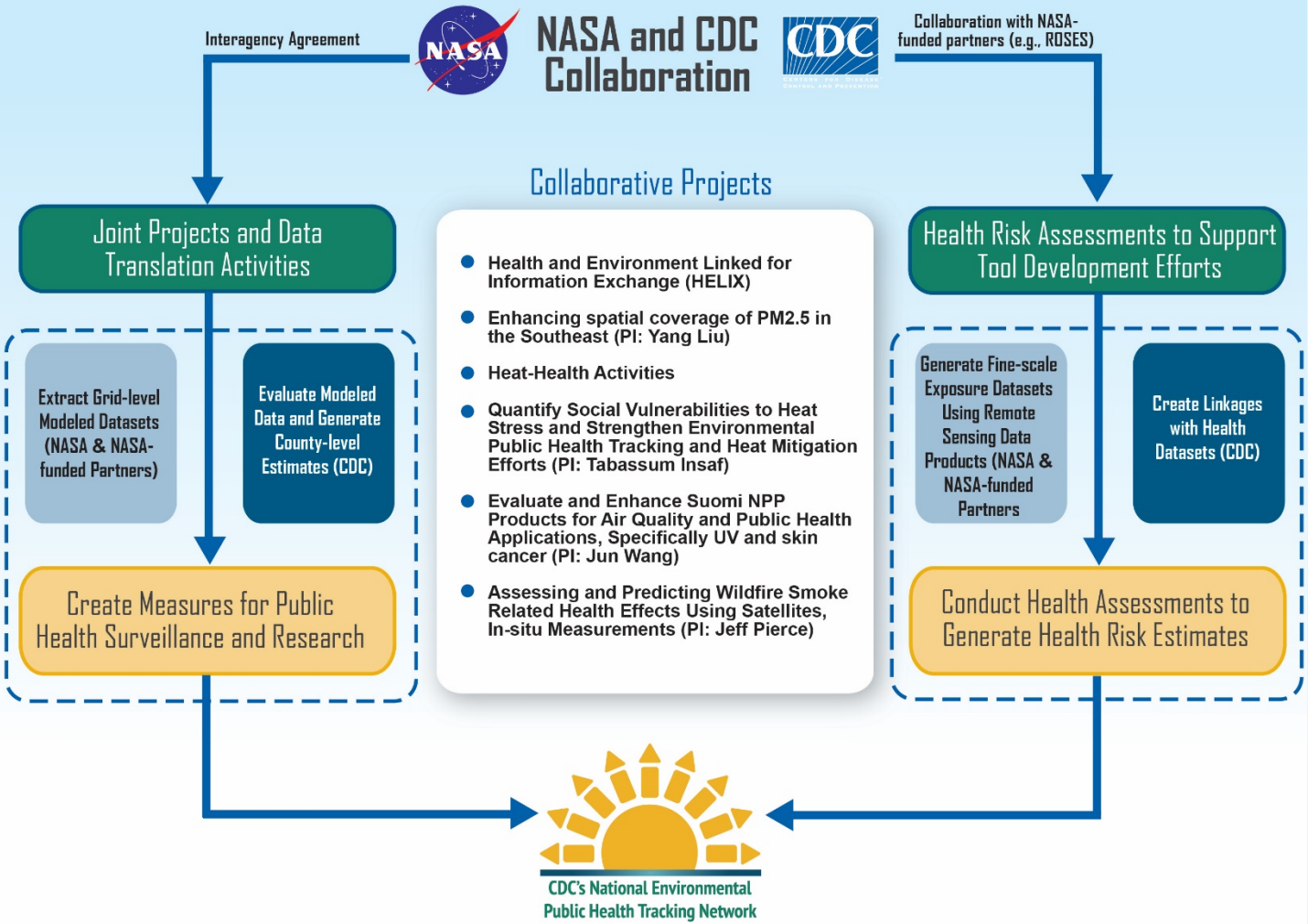
Driving Public Health Actions

- Detect and monitor trends
- Identify populations at risk
- Identify exposure to hazards
- Examine the relationship between hazards and disease
- Assess potential disease clusters or exposures
- Track progress
- Enhance surveillance
- Improve access to quality data

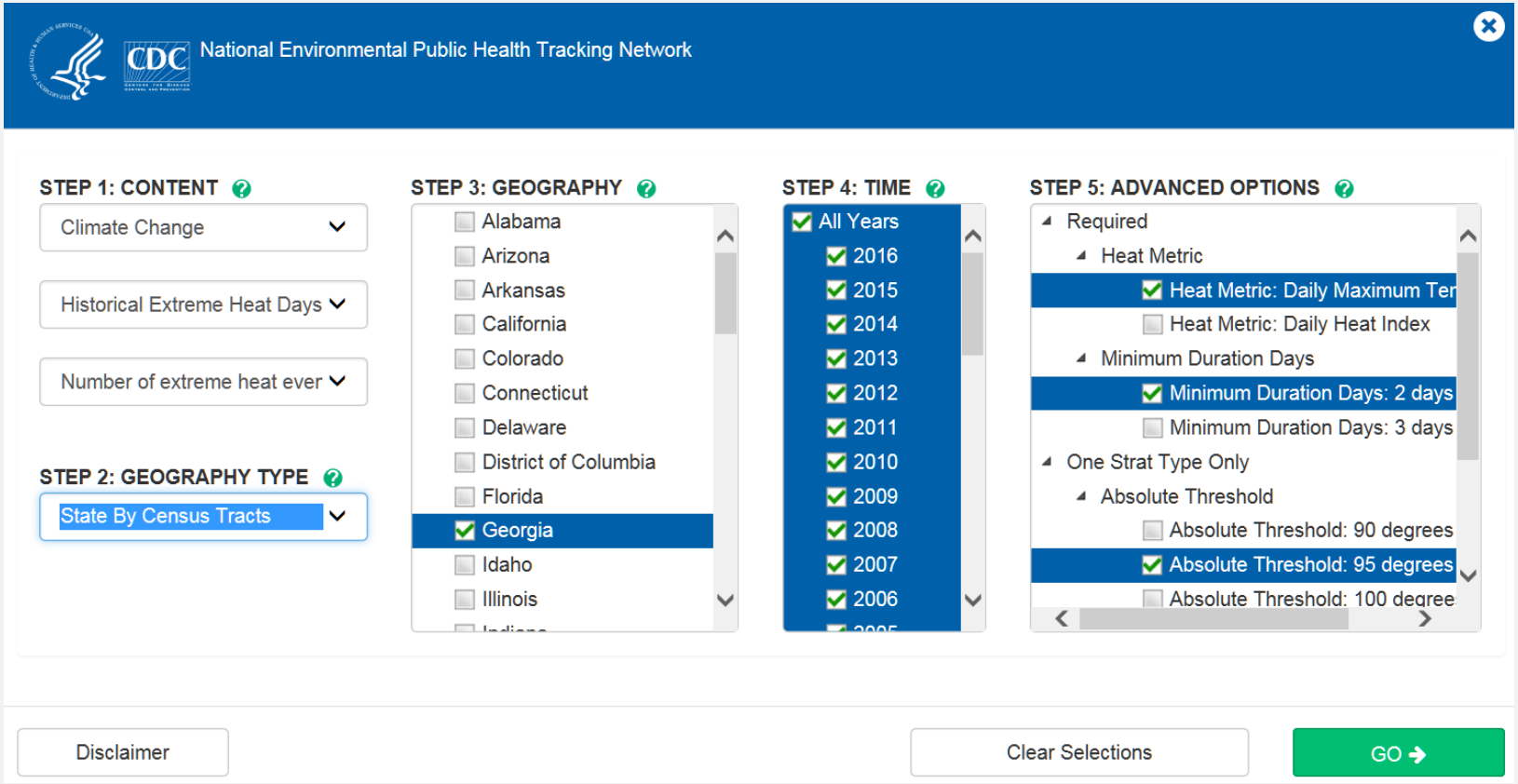
Informed, improved, evaluated…

programs, interventions, policies…

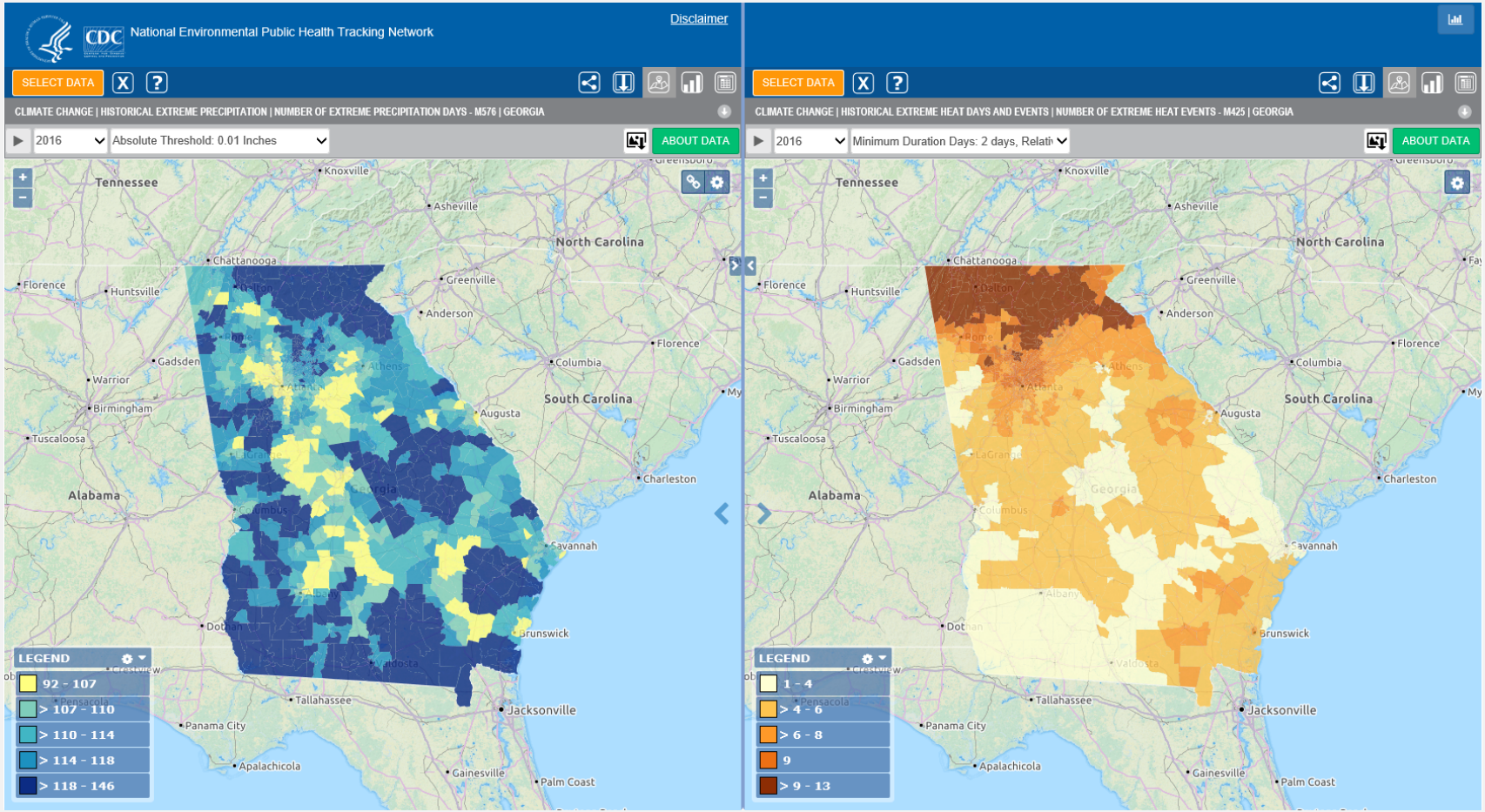
to address environmental health issues.


Interagency Agreement
NASA and CDC Collaboration
Collaboration with NASA-funded partners (e.g., ROSES)
Collaborative Projects
Joint Projects and Data Translation Activities
Health Risk Assessments to Support Tool Development Efforts
Extract Grid-level Modeled Datasets (NASA & NASA-funded Partners)
Evaluate Modeled Data and Generate County-level Estimates (CDC)
Generate Fine-scale Exposure Datasets Using Remote Sensing Data Products (NASA & NASA-funded Partners
Create Linkages with Health Datasets (CDC)
Health and Environment Linked for Information Exchange (HELIX)
Enhancing spatial coverage of PM2.5 in the Southeast (PI: Yang Liu)
Heat-Health Activities
Quantify Social Vulnerabilities to Heat Stress and Strengthen Environmental Public Health Tracking and Heat Mitigation Efforts (PI: Tabassum Insaf)
Evaluate and Enhance Suomi NPP Products for Air Quality and Public Health Applications, Specifically UV and skin cancer (PI: Jun Wang)
Assessing and Predicting Wildfire Smoke Related Health Effects Using Satellites, In-situ Measurements (PI: Jeff Pierce)
Create Measures for Public Health Surveillance and Research
Conduct Health Assessments to Generate Health Risk Estimates
CDC's National Environmental Public Health Tracking Network

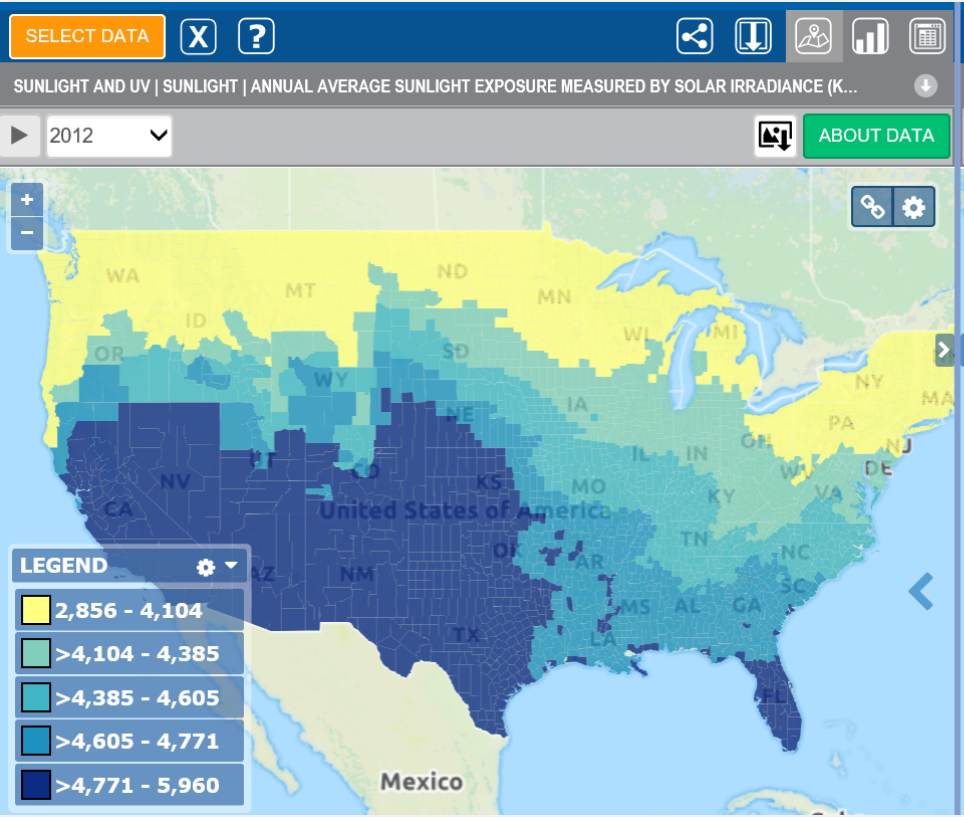
Historical Time-Series of Daily Heat Metrics at the Community level

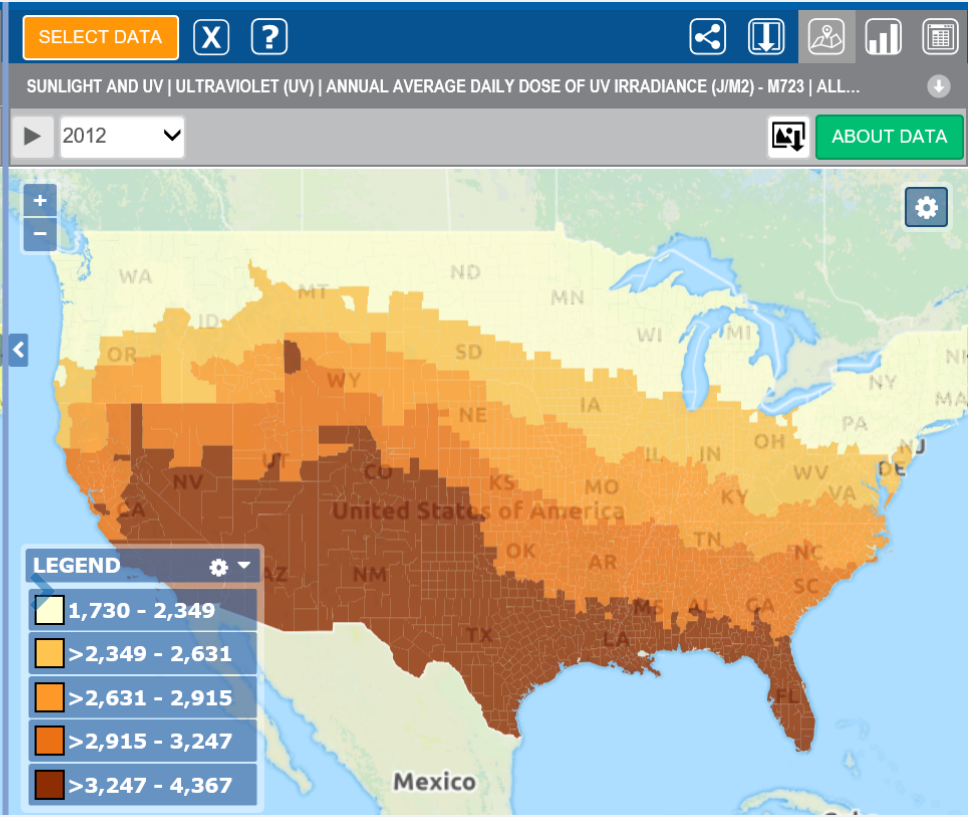


Historical Extreme Heat and Precipitation Metrics



UV and Solar Metrics





Developed by Environmental Remote Sensing Group at the Rollins School of Public Health at Emory University. UV based on University of Iowa's OMI Level 2 Surface UV Irradiance Product. Solar based on National Solar Radiation Data Base (1991-1997) and SolarAnywhere (1998-2012).

Heat – Health Activities: Motivation

- Characterize the relationship between extreme heat and health outcomes
  - Develop a heat-health risk profile for disease- or cause-specific deaths and illnesses over a wide-range of summertime temperature ranges
- Identify extreme heat triggers that correspond with significant health risks
  - Compile a list of region- and state-specific exposure-response relationships between daily heat metrics and health outcomes
- Compare existing temperature ranges used for issuing heat-related alerts with thresholds that are appropriate from a health perspective
- Ultimately develop an online tool for mitigating adverse health impacts associated with extreme temperatures

Heat – Health Activities: Data and Methods

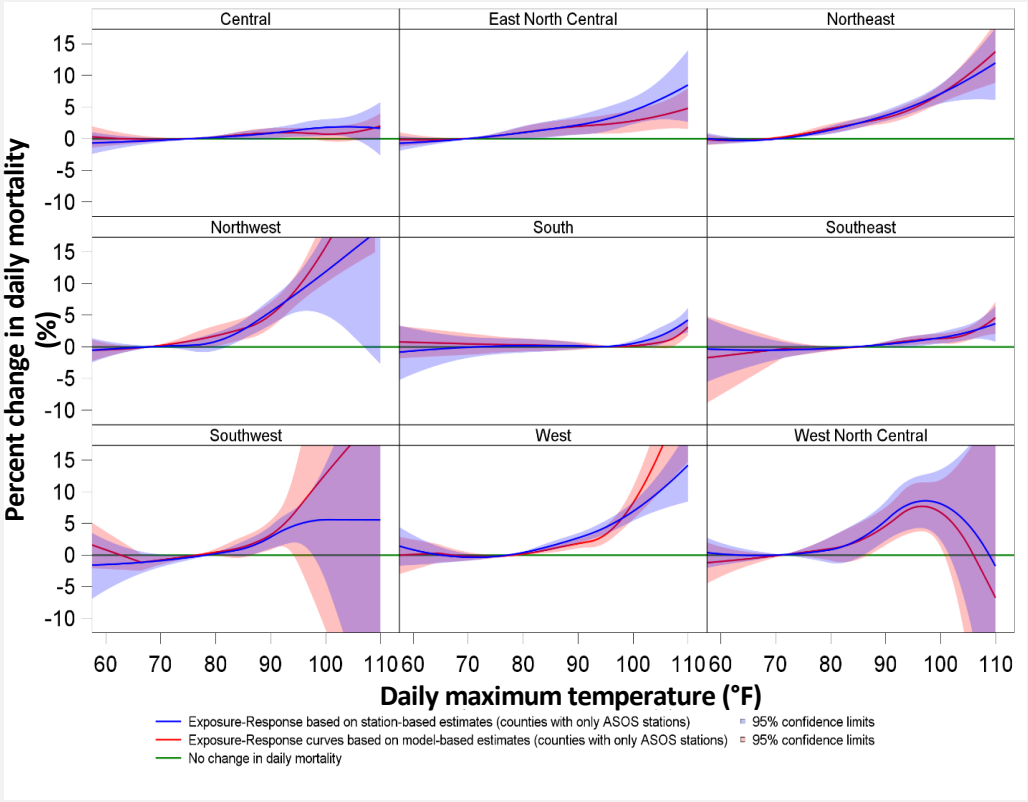
Data Sources

- Estimates of daily heat metrics obtained from North American Land Data Assimilation System (NLDAS)
- Mortality data from National Vital Statistics System
- Non-fatal hospital admissions and emergency department (ED) visits data from the databases of Healthcare Cost and Utilization Project
  - Disease outcomes included in this analysis: all-causes, acute renal failure, fluid and electrolyte disorders, respiratory and cardiovascular diseases

Methods

- Two-stage analysis to estimate heat-health risk relationships for deaths and illnesses
  - First stage involves a county-level time series analysis using a Distributed Lag Non-Linear Model (DLNM) for the summer months (May 1 through September 30)
  - Second stage involves a pooled analysis to summarize county-specific risks, generated using the DLNM approach, across larger geographic scales

Heat – Health Activities: Results and Translation



- Association varies by geography and health outcome
- "Heat-attributable burden starts to occur at moderately hot heat index values, which in some regions are below the alert ranges used by the NWS during the study time period"
- Results shared with National Weather Service
- Future integration of results with real-time heat alerts on Tracking Network

Vaidyanathan A, et al. Assessment of Extreme Heat and Hospitalizations to Inform Early Warning Systems. Under journal review.

Wildfire Smoke – Health Activities: Motivation

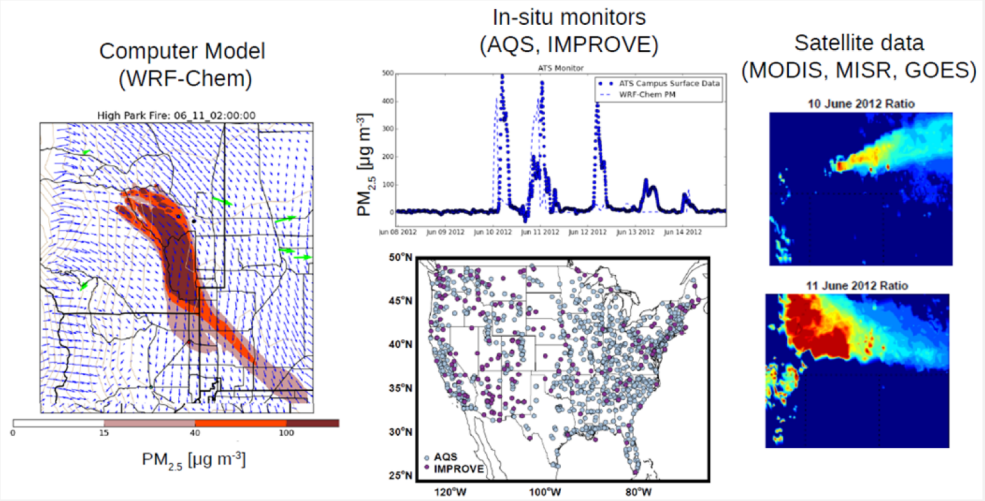
- CDC has been working with partners to develop an online tool for identifying at-risk populations to wildfire smoke hazards
  - Tool will incorporate standardized health and exposure datasets, and prevention guidelines related to wildfire smoke hazards

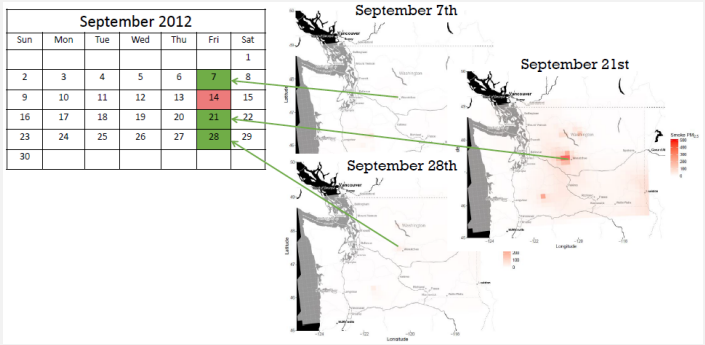
- CDC is collaborating with Colorado State University, USFS, and state partners to:
  - Conduct a vulnerability assessment in areas impacted by wildfires/wildfire smoke hazards
  - Generate smoke predictions for historical wildfire episodes
  - Understand the impact of smoke predictions on human health outcomes

- Conducted a pilot analysis for Washington fires, 2012

Wildfire Smoke – Health Activities: Data and Methods

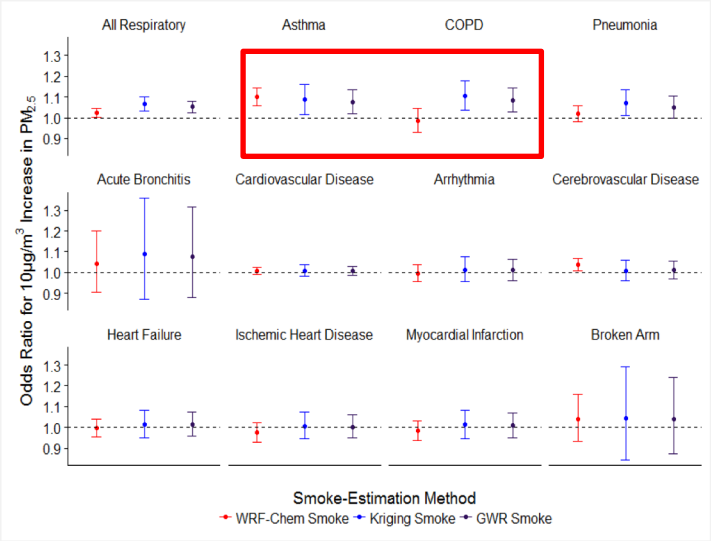
- Exposure modeling
  - Generate estimates using different data sources and methods
  - Evaluate different data sources against measurements
  - Derived estimates using hybrid approach
- Epi analysis
  - Case-crossover analyses
  - Controls for temperature, humidity, wind speed (meteorological data from NLDAS)



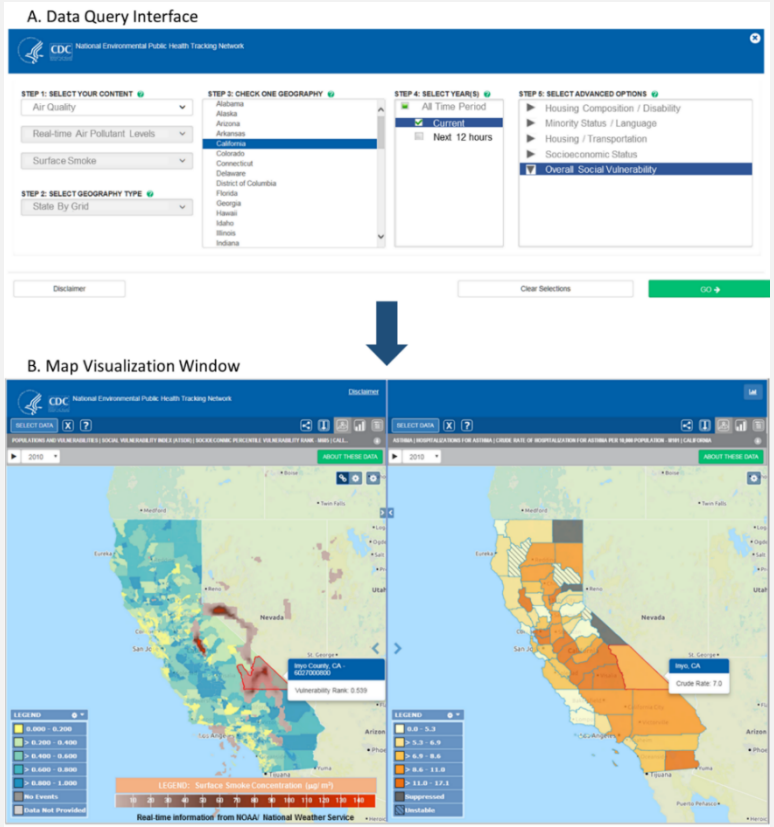


Gan RW et al. Comparison of wildfire smoke estimation methods and associations with cardiopulmonary-related hospital admissions. Geohealth. 2017 Mar;1(3):122-136.

Wildfire Smoke – Health Activities: Results and Translation



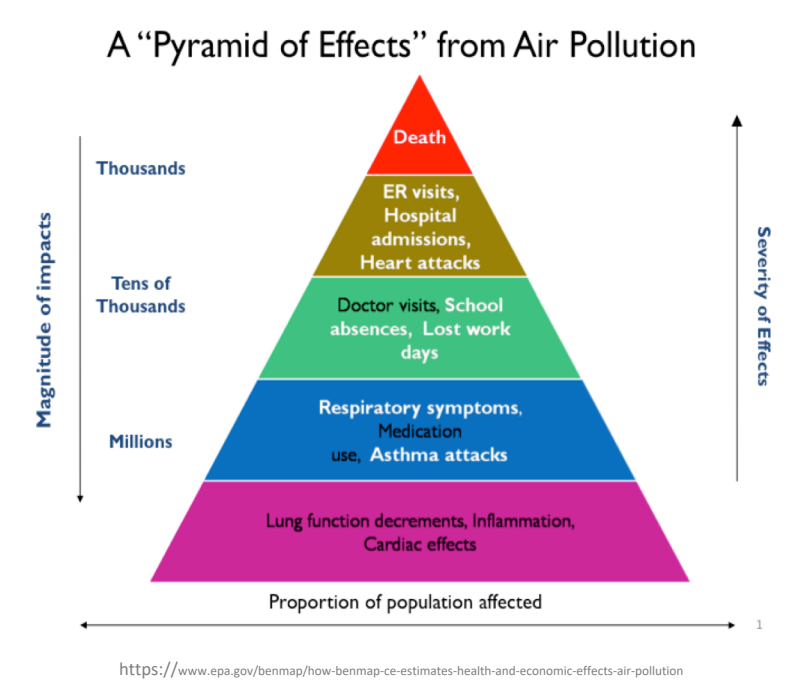
- Expand to include other wildfire episodes and compile a library of concentration – response (C-R) functions for various locations in the Western United States



Vaidyanathan A, Yip F, Garbe P. (2017). Developing an Online Tool for Identifying At-Risk Populations to Wildfire Smoke Hazards. Science of the total environment (Accepted)

Air Pollution – Health Activities: Motivation

- Strong evidence of an association with respiratory morbidity and mortality
  - Ozone = Causal
  - $PM_{2.5}$ = Likely causal
- Multi-city studies provide robust data points for national policy setting
  - Mortality
  - Morbidity in 65+ years
- Evidence for respiratory morbidity in persons <65 years
  - International multi-city studies
  - Single-city studies



Air Pollution – Health Activities: Data and Methods

- Data
  - Daily, county respiratory ED visits in 17 states
  - Downscaler model estimates for ozone and $PM_{2.5}$
  - Temperature and dew point temperature from NLDAS data

- Methods
  - Two stage analysis
  - First county specific time-series models
  - Second pull county results using Bayesian hierarchical model

Air Pollution – Health Activities: Results and Translation

Ozone

Outcome	Age Group	Rate Ratio (95% CI)
All	All	1.039 (1.036, 1.042)
All	0 to <19	1.022 (1.017, 1.027)
All	19 to <65	1.051 (1.047, 1.055)
All	65 or older	1.033 (1.027, 1.039)

Ozone with $PM_{2.5}$

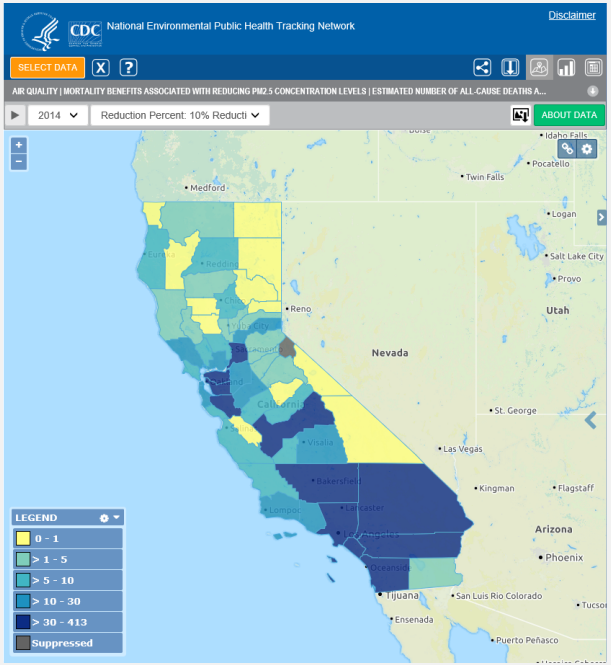
Rate Ratio (95% CI)
1.037 (1.033, 1.041)
1.017 (1.011, 1.023)
1.051 (1.046, 1.056)
1.033 (1.026, 1.040)

$PM_{2.5}$

Outcome	Age Group	Rate Ratio (95% CI)
All	All	1.020 (1.017, 1.023)
All	0 to <19	1.024 (1.019, 1.029)
All	19 to <65	1.020 (1.016, 1.024)
All	65 or older	1.008 (1.002, 1.013)

$PM_{2.5}$ with Ozone

Rate Ratio (95% CI)
1.011 (1.008, 1.015)
1.024 (1.018, 1.029)
1.008 (1.004, 1.012)
1.002 (0.996, 1.007)



- Significant positive associations for all age groups between all respiratory ED visits and both pollutants
- Future work to generate morbidity benefits associated with reductions in PM2.5 and ozone

Strosnider, Chang, Darrow, Liu, Vaidyanathan, Strickland. Age-specific associations of ozone and PM2.5 with respiratory emergency department visits in the US. Accepted.

Looking Forward – Opportunities for Collaboration

- Characterize exposure, vulnerabilities, and health impacts to take action
  - Wildfires and prescribed burnings: forest, agricultural
  - Air pollution: Traffic-related pollutants
  - Climate-related events and natural/manmade disasters: Heat, HABs

- Joint collaborations to assess the effectiveness of policy and other interventions on reducing health impacts
  - Quantify changes in AQ concentrations/sources, in places with no monitors

- Using the Tracking Network as a Decision Support System and as a platform to host earth science data products
  - Need expertise and resources to transform raw data for public health
  - Need repeatable, sustainable data products to support ongoing surveillance

Thank you

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CAPT Fuyuen Yip, PhD, MPH, Section Chief (acting)

Environmental Health Tracking Section
Lead Poisoning Prevention and Environmental Health Tracking Branch
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CDC Public Health Grand Rounds Presentation and "Beyond the Data":
Tracking Environmental Health Data for Public Health Decision Making
http://www.cdc.gov/cdcgrandrounds/archives/2016/june2016.htm

For more information, contact NCEH/ATSDR
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