

**Environmental Public Health Tracking - Health  
and Environment Linked  
for Information Exchange-Atlanta (HELIX-  
Atlanta): A Cooperative Program Between CDC  
and NASA for Development of an Environmental  
Public Health Tracking Network in the Atlanta  
Metropolitan Area**

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Prevention*



# Public Health

- The science and art of preventing disease, prolonging life, and promoting health through organized efforts of society.



# Environmental Public Health

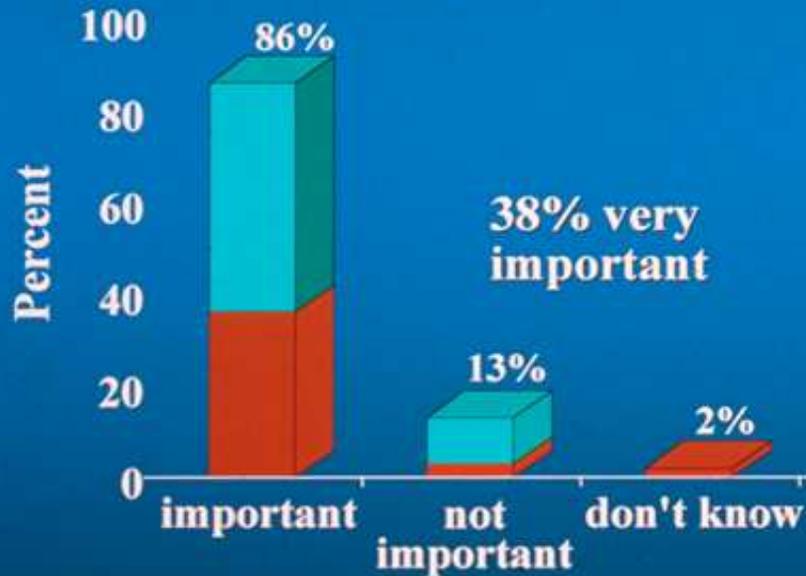
- Aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and psychosocial factors in the environment.
- The theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.



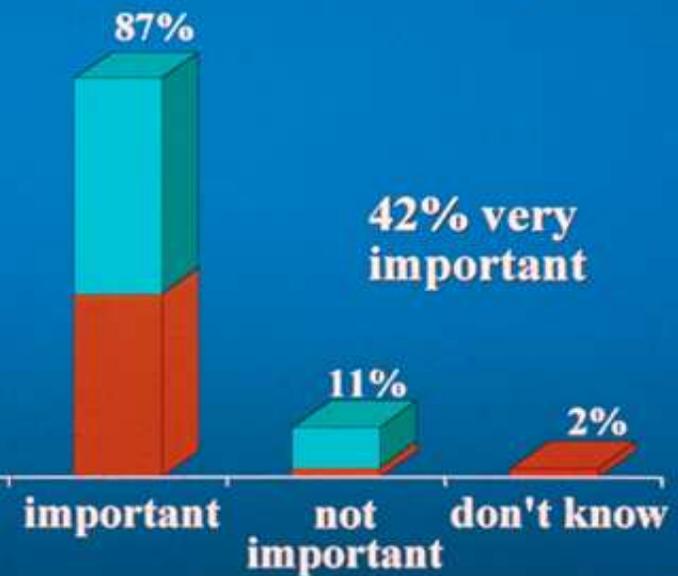
# The Public Overwhelming Believes That Environmental Factors Are A Major Cause Of Health Problems And Disease

## Positioning Environmental Factors As “Causes Of Disease” Or “Causes Of Increased Rates Of Disease” Makes No Difference

*Do you think environmental factors like pollution are...cause of diseases and health problems?*



*Do you think environmental factors like pollution are...cause of increased rates of diseases and health problems?*

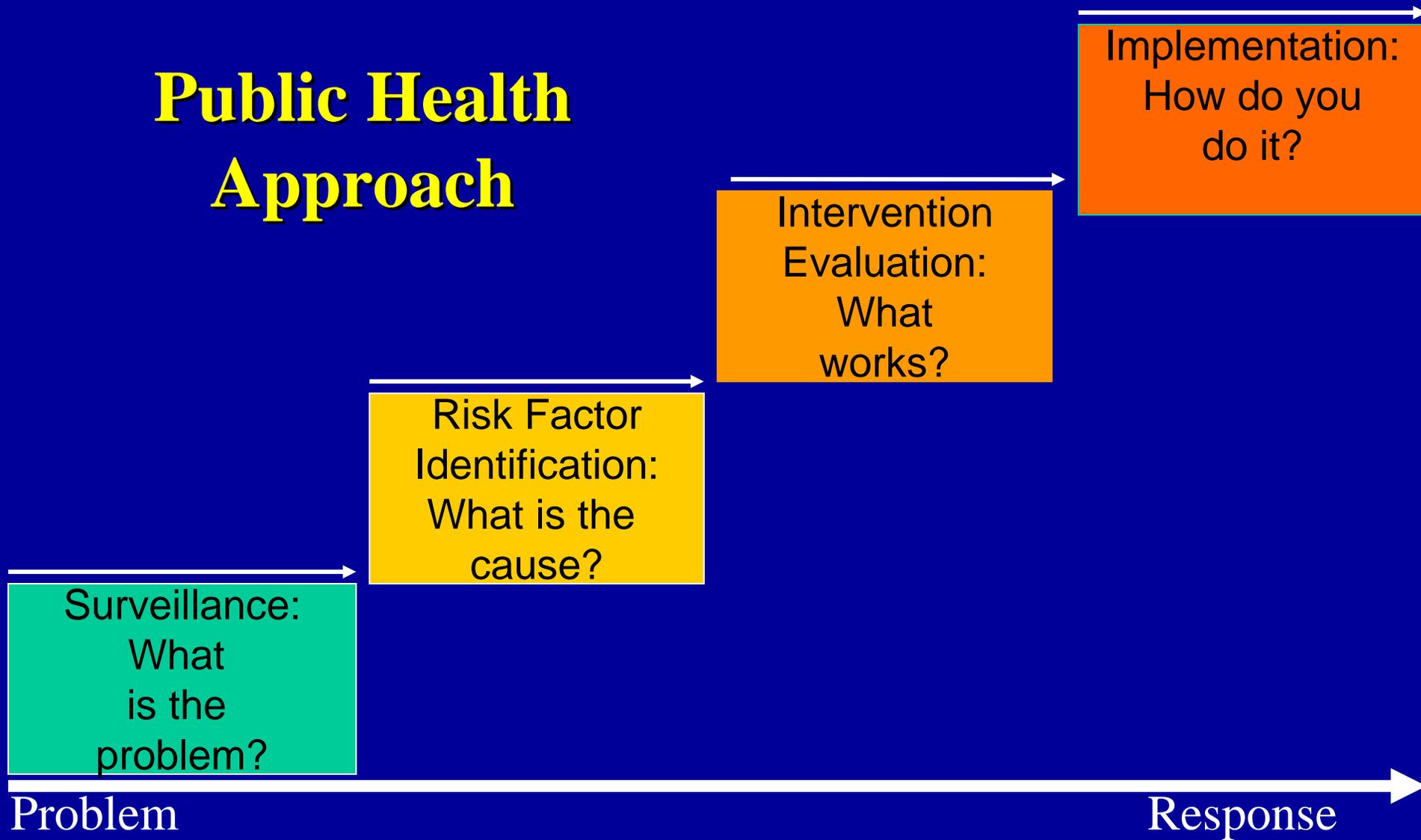


The Mellman Group Inc./Public Opinion Strategies 5/99

(darker shade=stronger intensity)



# Public Health Approach



# Public Health Surveillance

- **Ongoing systematic collection, analysis, and interpretation of outcome-specific data used to plan, implement, and evaluate public health practice.**



# Types of PH Surveillance

- **Prevalence**
  - All cases
- **Incidence**
  - Newly diagnosed cases
- **Active**
  - Health department initiated
- **Passive**
  - Health care provider initiated



# Surveillance Information Uses

- Monitor & detect changes in the magnitude & distribution of selected events
- Develop hypotheses for research
- Evaluate interventions
- Facilitate public health decision-making



# Health Effects, Exposures, Hazards

## Health Effects

- Asthma
- Poisoning – heavy metal; CO; pesticides
- Cancer
- Birth Defects
- Other adverse reproductive outcome such as low birth wt, preterm birth
- Developmental disabilities
- Other chronic respiratory disease
- Multiple Sclerosis
- Cardiovascular Disease
- Systemic Lupus Erythematosus
- Amyotrophic lateral sclerosis

## Exposures/Hazards

- PCBs
- Heavy metals
- Pesticides
- Environmental tobacco smoke
- Radionuclides
- Asbestos
- Other drinking water contaminants such as trihalomethanes, PCE, TCE,
- Outdoor air contaminants such as particulate mater, ozone, CO and air toxics
- Indoor air contaminants such as mold, carbon monoxide



# Measuring Public Health

- **How do we measure progress towards the aim of public health to prevent disease & promote health?**
  - Idea of systematically observing, recording, collecting, & analyzing data for intervention stems from Hippocrates
- **What events should be under surveillance?**
  - System for organizing and classifying health-related information
  - Uniform surveillance endpoints
  - Translates complex knowledge into simple units of information for communication



# Tracking = Public Health Surveillance

- Environmental public health tracking is the ongoing, systematic collection, integration, analysis, and interpretation of data about the following factors:
  - environmental hazards
  - human exposure to environmental hazards
  - health effects potentially related to exposure to environmental hazards
- Data must be disseminated to plan, implement, and evaluate environmental public health action



**CDC's National  
Environmental Public Health Tracking (EPHT)  
Program initiated in 2002**

- **Congressional funding for  
*development and implementation of a  
nationwide environmental health  
tracking network and capacity  
development in environmental health  
at State and local health  
Departments'***

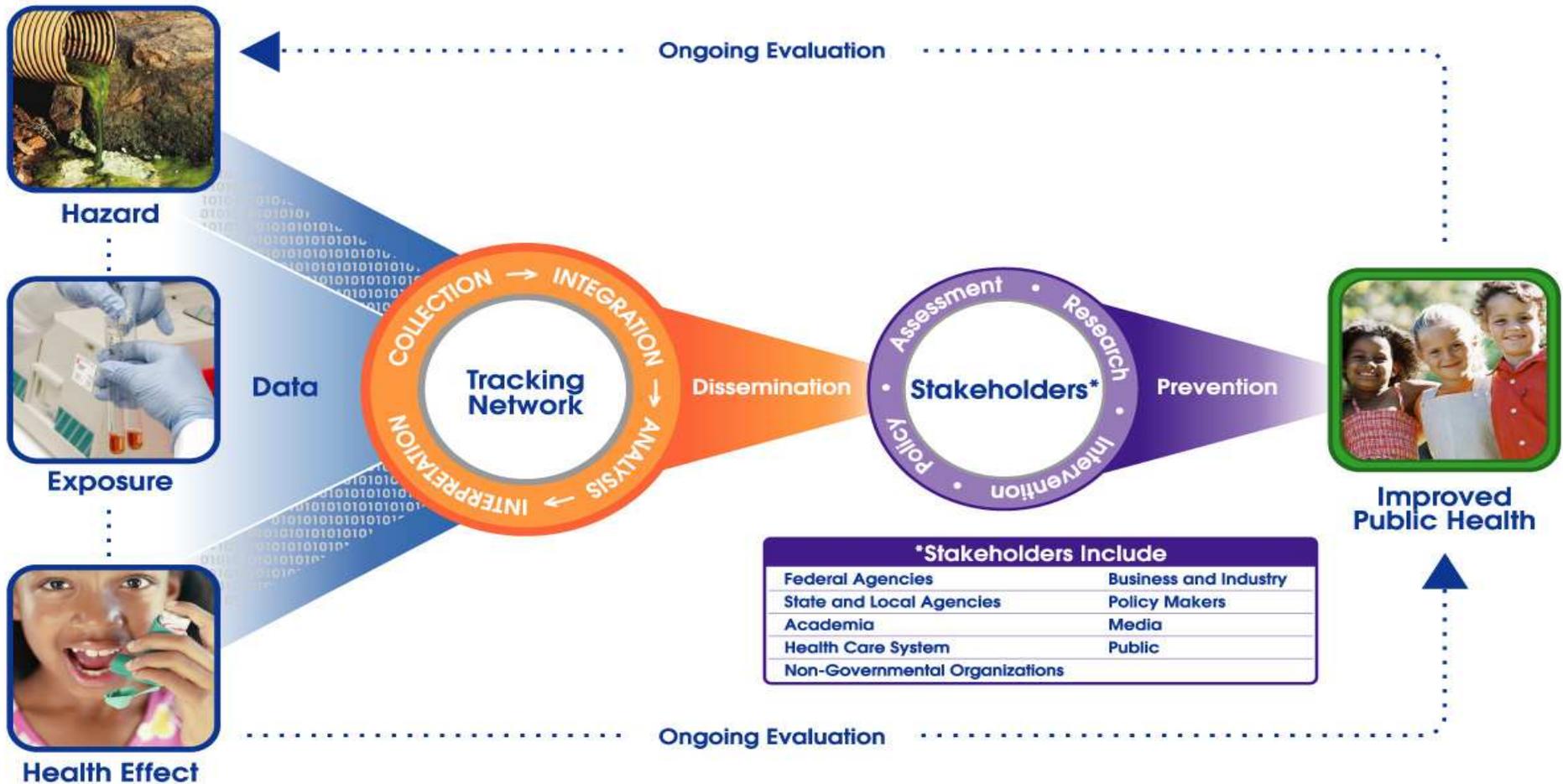


## **Selected EPHT Network Features**

- **Tools for linkage, visualization, analysis, generation of alerts, & reporting**
- **Internet-based**
- **Standards-based**
- **HIPAA compliant**
- **Access to the network is based on role & purpose**



# ENVIRONMENTAL PUBLIC HEALTH TRACKING



**\*Stakeholders include**

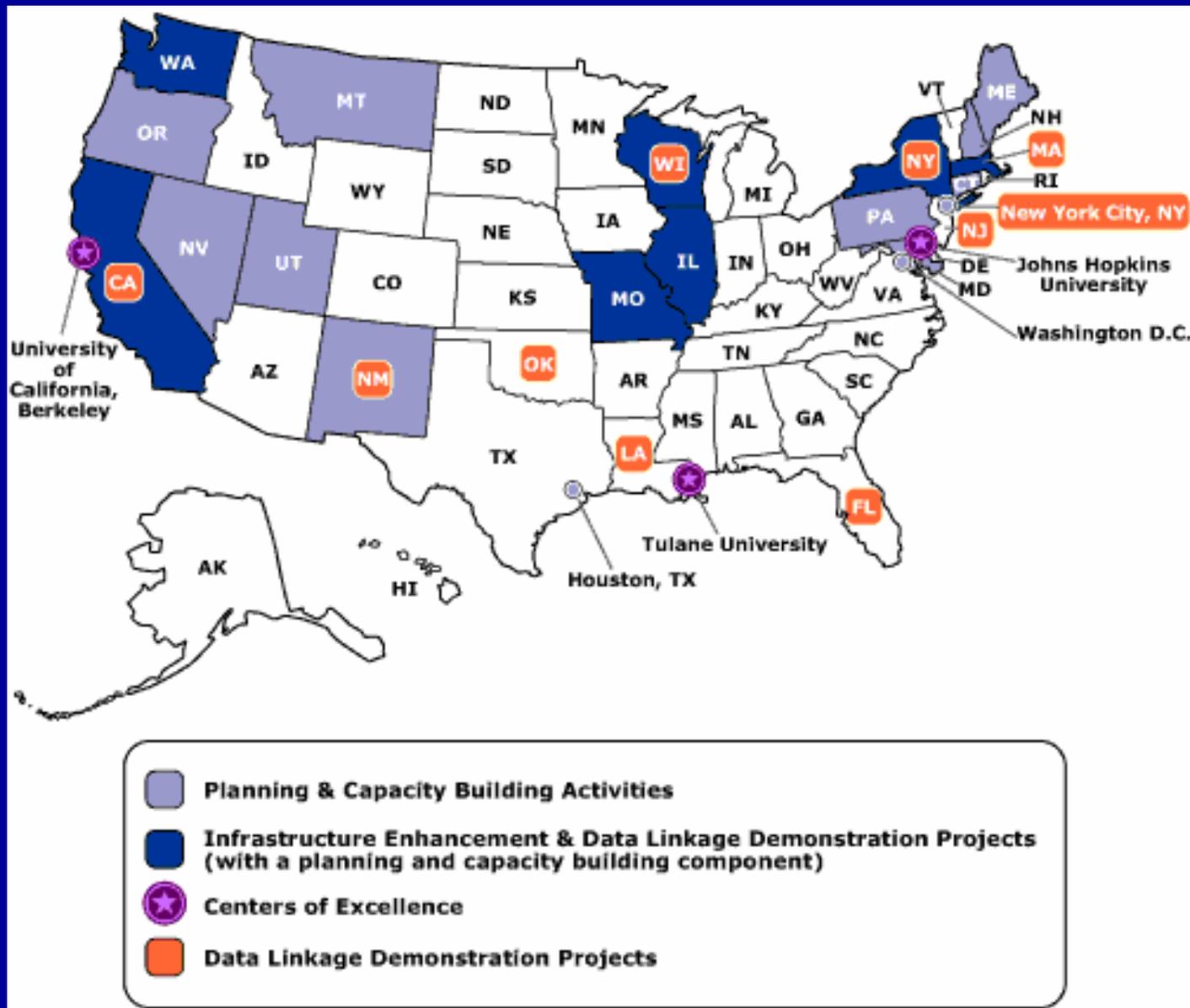
Federal Agencies	Business and Industry
State and Local Agencies	Policy Makers
Academia	Media
Health Care System	Public
Non-Governmental Organizations	



**DEPARTMENT OF HEALTH AND HUMAN SERVICES  
CENTERS FOR DISEASE CONTROL AND PREVENTION  
SAFER • HEALTHIER • PEOPLE**



# National Environmental Public Health Tracking Program 2003



# Public Health Surveillance Objectives

- Estimate the magnitude of a health effect in the population at risk
- Understand the natural history of a health effect
- Detect health effect outbreaks/clusters or epidemics
- Document the distribution and spread of a health effect
- Develop hypotheses about etiology
- Monitor and evaluate interventions
- Monitor and detect changes
- Assess quality and safety of health care
- Identify research needs and facilitate epidemiologic and laboratory research
- Facilitate planning



# PH Surveillance System Attributes

- **Simplicity**
- **Flexibility**
- **Data quality**
- **Acceptability**
- **Sensitivity (ability to detect)**
- **Predictive value positive (false-positives)**
- **Representative**
- **Timeliness**
- **Reliability**



# Planning a PH Surveillance System

1. Establish objectives
2. Develop case (event) definitions
3. Determine data sources, data collection mechanisms, and type of system
4. Develop data collection instruments
5. Field-test methods
6. Develop and test an analytic approach
7. Develop a dissemination mechanism
8. Assure use of analysis and interpretation



## HELIX-Atlanta

- Provide information regarding the 5-county Metro-Atlanta Area
  - Clayton, Cobb, DeKalb, Fulton, & Gwinnett
- Integrate environment & public health data into a local network that is part of a national network
- Take action to prevent & control environmentally related health effects



# HELIX-Atlanta Purpose and Goals

To enable different environmental and non-infectious public health information systems to build bridges to communicate with each other for environmental public health surveillance.



**Goal #1:**  
*Build a Sustainable 5-County Metropolitan Atlanta Area EPHT Network consistent with the national EPHT Network*



**Goal #2:**  
*Increase EPHT Capacity in the 5-County Metropolitan Atlanta Area*



**Goal #3:**  
*Disseminate Credible Information*



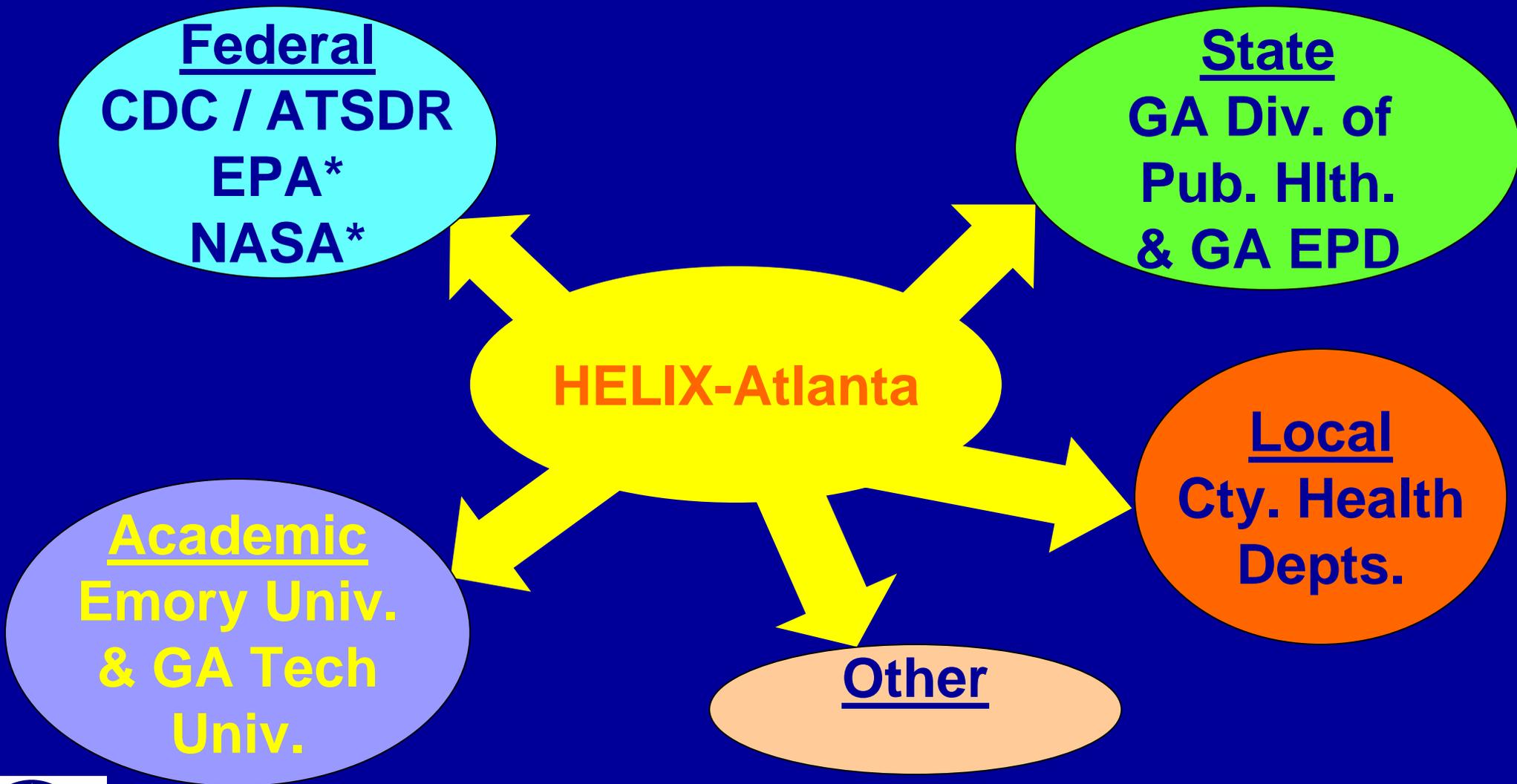
**Goal #4:**  
*Advance Environmental Public Health Science and Research*



**Goal #5:**  
*Build Bridges Between Health and Environment in the 5-County Metropolitan Atlanta Area*



# HELIX-Atlanta Partners



\* Memorandums of Understanding (MOUs)



# HELIX-Atlanta Projects

- **Birth Defects**
  - Integrate data for air & birth defects
- **Developmental Disabilities & Lead**
  - Integrate data for housing age, blood lead biomonitoring, & developmental disabilities
- **Cancer**
  - Integrate data from traffic & childhood cancers
- **Asthma**
  - Select a standardized classification system & evaluate existing data sources
- **Water**
  - Identify data gaps & strengths



# What Do We Have?

## Partnerships

- **Memorandums of Understanding**
  - CDC/EPA (existing)
  - CDC/NASA (existing)
- **Public Health and Environmental Partners**
  - Federal
  - State
  - Local
  - Academic
  - Other
- **National Environmental Public Health Tracking Cooperative Agreements (33)**
  - State
  - Local
  - Academic



# HELIX-Atlanta Approach

- **Network has shared functionality**
- **Network is a tool to access interoperable information systems with optional linkage functionality**
  - Information technology linkages driven by scientific rationale
  - Agreed upon core ongoing linkages to respond to priorities
  - Linkage, analysis, and other functions sit within the network, but outside the information systems
  - Agreed upon standards used for data exchange and access



# What Do We Have?

## Public Health Databases

- **Existing Surveillance Information Systems in 5-County Metropolitan Atlanta Area**
  - \*Metropolitan Atlanta Congenital Defects Program (MACDP)
  - \*Metropolitan Atlanta Developmental Disabilities Surveillance Program (MADDSP)
  - \*Georgia Perinatal Surveillance/Vital Records
  - \*Georgia Childhood Lead Poisoning Prevention Program
  - National Adult Blood Lead Epidemiology and Surveillance
  - \*Surveillance, Epidemiology, and End Results (SEER) Atlanta Registry
  - Other
- **Existing Information Systems (not surveillance or not local level)**
  - Emory Study of Particles and Health in Atlanta (SOPHIA)
  - \*Asthma/Respiratory Health
  - Other

**\*Selected at October 30, 2003 HELIX-Atlanta Partners Working Meeting**



# What Do We Have?

## Environmental Monitoring Databases

- **\*EPA air quality monitoring**
  - Criteria air pollutants
  - Air toxics
  - National Air Toxics Assessment Analysis (NATA)
- **EPA emissions inventories**
- **EPA drinking water monitoring**
- **EPA other monitoring**
- **\*HUD lead in housing monitoring**
- **USGS source water monitoring**
- **\*NASA remote sensing**
  - Land surface temperature
  - Particulate matter
- **Other**

**\*Selected at October 30, 2003 HELIX-Atlanta Partners Working Meeting**



# **What Do We Do?**

## **Implementation**

- **Evaluate database(s) for use in HELIX-Atlanta**
- **Develop partnerships**
  - Obtain authorization to access data (trading partner agreements)
- **Develop plan to prepare and compile data for linkage**
- **Identify appropriate analysis techniques and tools**
  - Who does analysis?
  - What is the frequency of analysis?
- **Be compliant with standards and specifications of the Public Health Information Network (PHIN)**
- **Be interoperable with the EPA National Environmental Information Exchange Network (NEIEN)**
- **Develop a Technical Implementation Plan**
  - Address other architecture, software, and electronic communications questions
- **Obtain IRB and OMB Approval or Exemption**



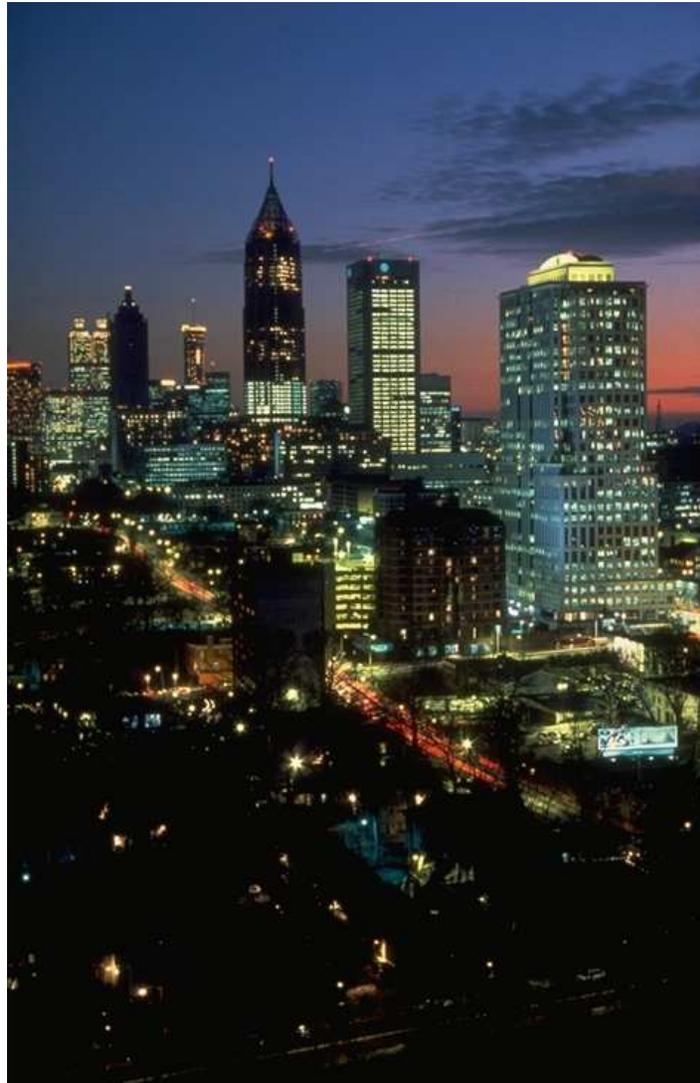
# What Do We Do?

## Timeline

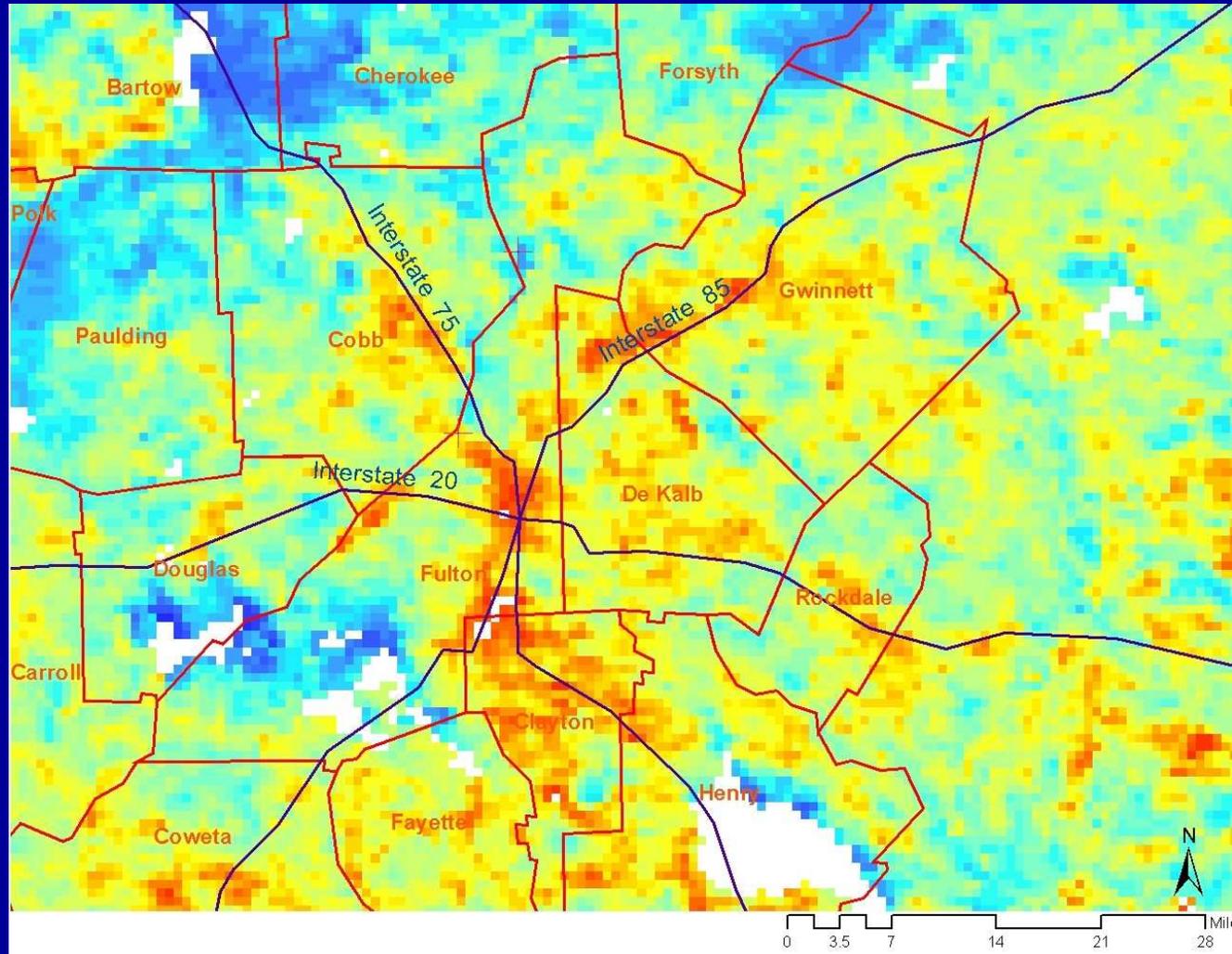
- **January 2004**
  - Confirm partners and roles
- **January 2004-June 2004**
  - Protocol development and planning (team & overall)
- **July 2004-December 2004**
  - IRB and OMB process
  - Ongoing
    - Communications
    - Evaluation
- **January 2005-December 2005**
  - Implementation
  - Ongoing
    - Communications
    - Evaluation
- **January 2006**
  - Recommendations for sustainability of network
  - Next steps
  - Communications
  - Evaluation



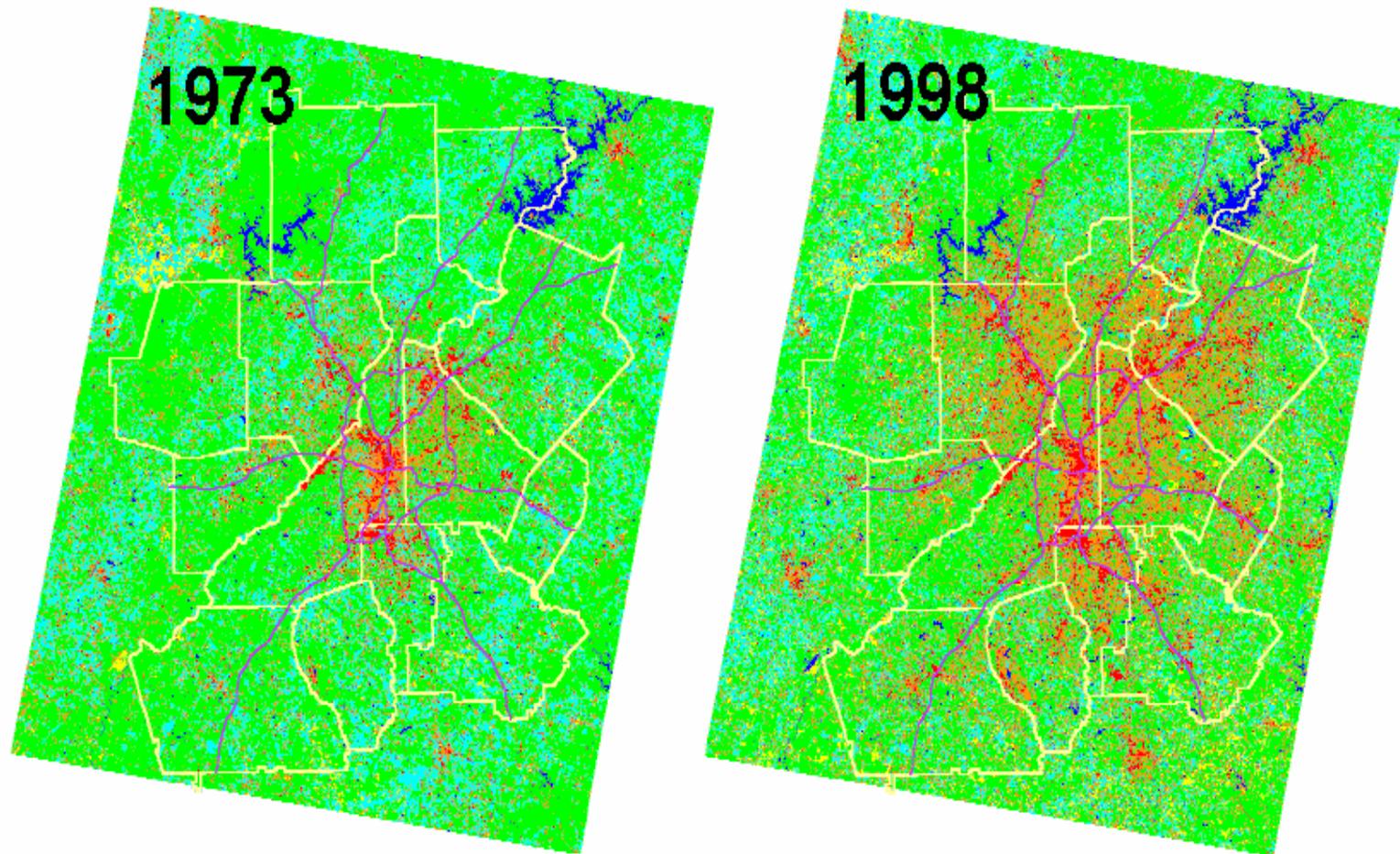
# Estimating Surface PM 2.5 Concentrations using NASA MODIS Satellite Data



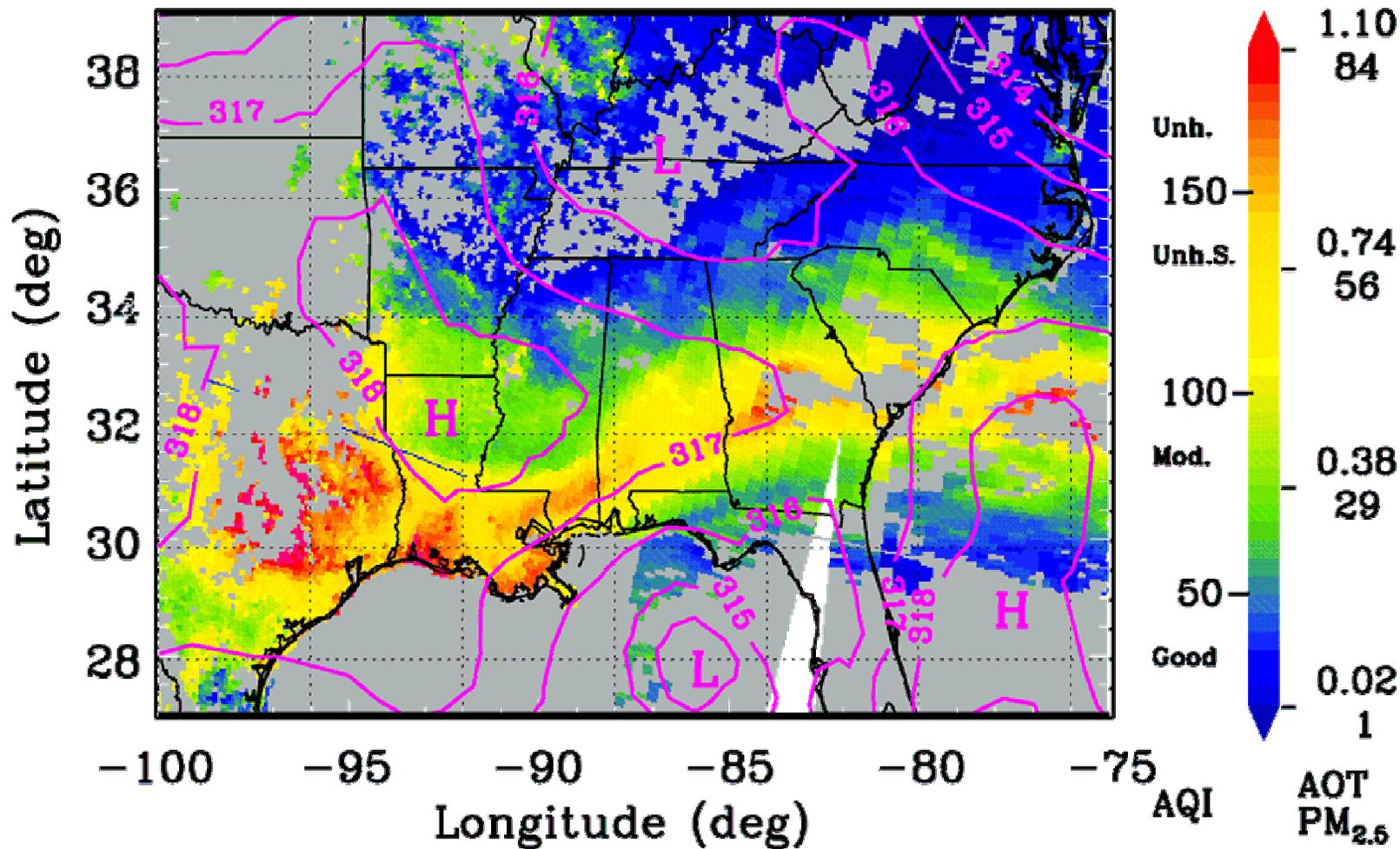
# Surface Temperature (MODIS)



# Land Use Change Data



# PM2.5 (inferred from MODIS data)



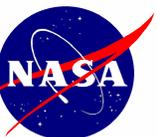
## Objective and Data Characteristics

### Objective:

Estimate daily PM<sub>2.5</sub> concentrations across the Atlanta area using data from NASA's MODIS satellite

### • MODIS Aerosol Optical Depth (AOD) characteristics:

- Provided on a 10x10 km grid
- Used in NOAA/EPA Air Quality Forecast Initiative to produce air quality forecasts for northeastern US; forecasts for entire US by 2009
- Available twice per day (~10:30 AM, 1:30 PM)
- Not available when clouds are present
- Available since spring 2000



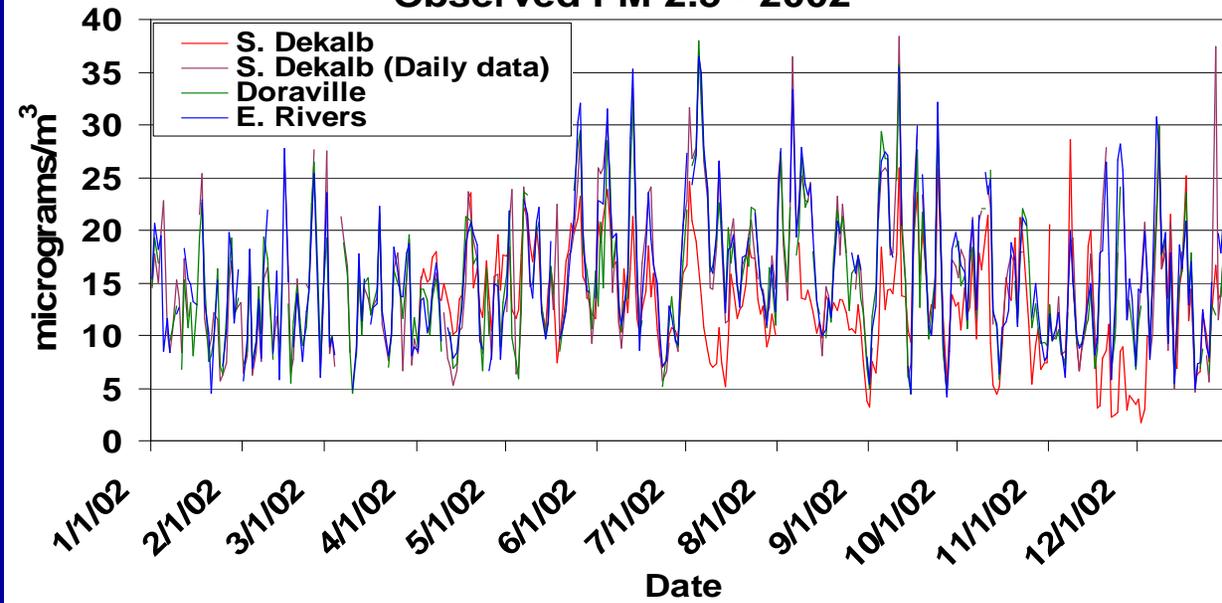
## Procedure

- For a base time period (2002-2003), obtain MODIS Aerosol Optical Depth (AOD) and EPA AQS PM<sub>2.5</sub> data
- Extract AOD data for AQS site locations
- Calculate daily averages from hourly AQS PM<sub>2.5</sub> data
- Using daily PM<sub>2.5</sub> averages from hourly sites, as well as daily values from sites reporting daily, determine statistical regression equations between and PM<sub>2.5</sub> MODIS AOD
- Also determine regression equations using mean values across all sites
- Apply regression equations to estimate PM<sub>2.5</sub> for each 10 km grid cell across region



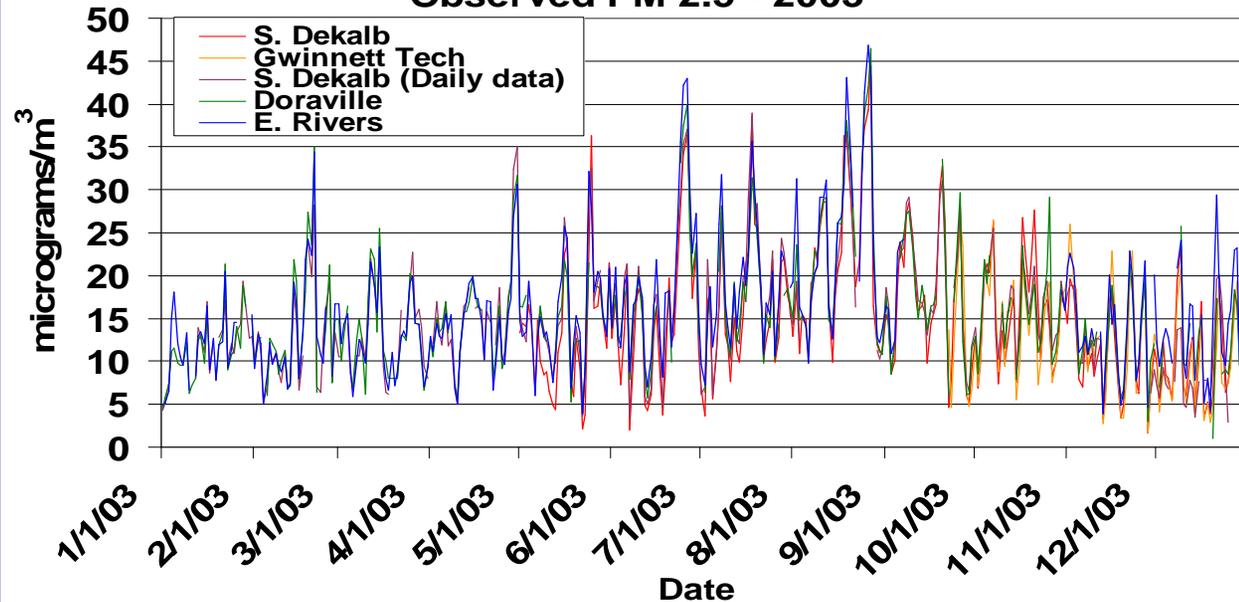
## PM 2.5 Data Examples

### Observed PM 2.5 - 2002

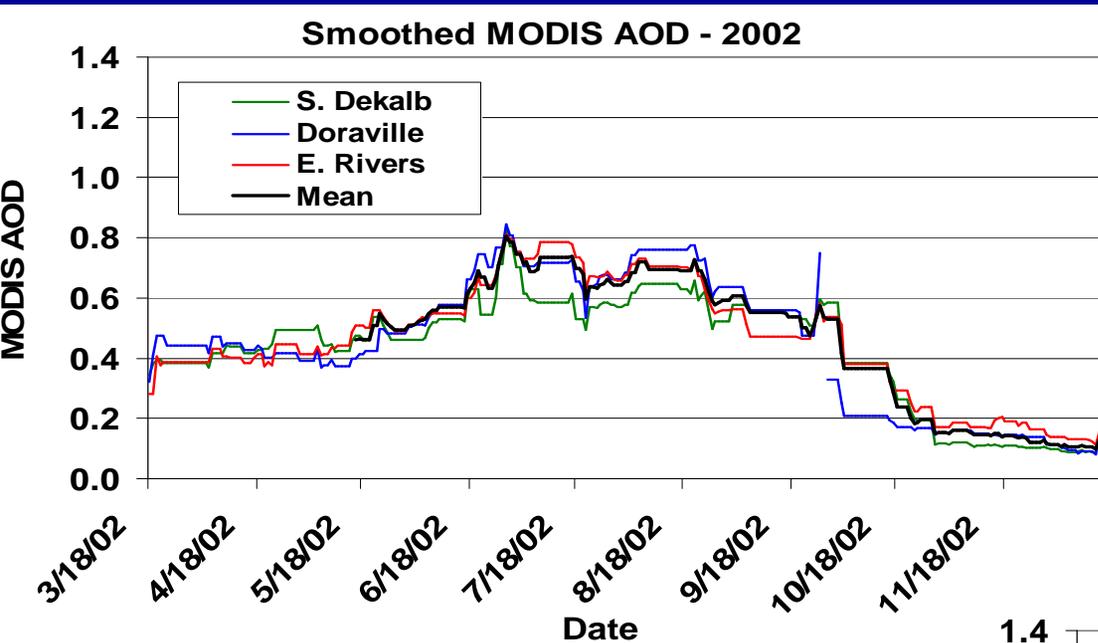


- Excellent agreement between measurements at multiple sites each day
- Only slight seasonal variations
- Large day-to-day variations

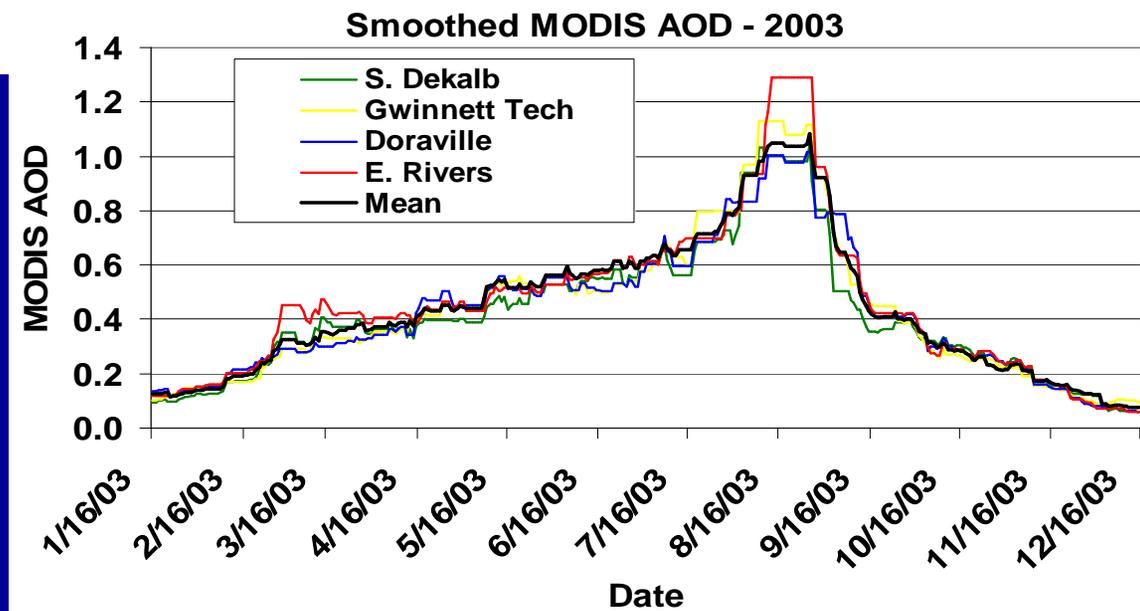
### Observed PM 2.5 - 2003



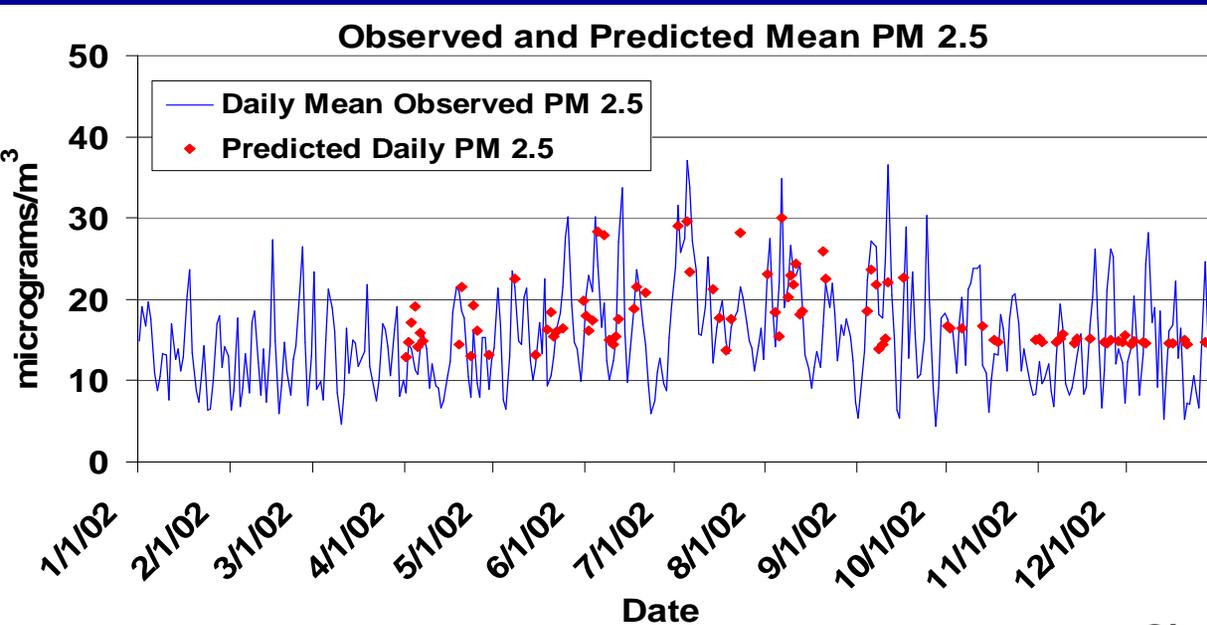
# MODIS Aerosol Optical Depth (AOD) Data Examples



- 31-day averages at each site and mean of all sites
- 2003 shows higher summer values and more seasonal variation



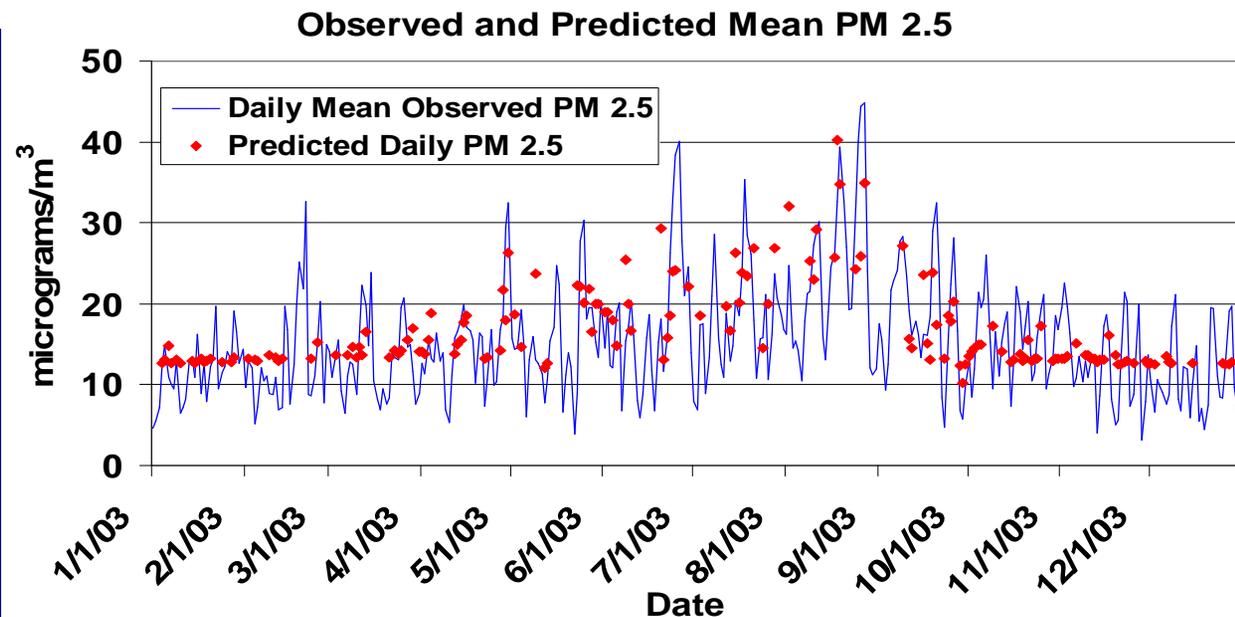
## Observed and Predicted PM 2.5



- Daily all-site means of observed and predicted PM<sub>2.5</sub>
- MODIS-based predictions follow seasonal PM<sub>2.5</sub> patterns
- MODIS AOD is nearly constant in fall and winter, while observed PM<sub>2.5</sub> is not

2002

2003



## PM 2.5 – MODIS AOD Correlations

		S. Dekalb	Doraville	E. Rivers	Means
<b>2002</b>	All days -->	0.526	0.616	0.543	0.593
	April-Sept -->	0.605	0.601	0.581	0.598
	Oct. - Dec. -->	0.126	0.197	0.036	0.137

		S. Dekalb	Gwinnett Tech	Doraville	E. Rivers	Means
<b>2003</b>	All days -->	0.653	0.400	0.740	0.606	0.690
	April-Sept -->	0.618	0.975	0.743	0.704	0.687
	Oct. - Dec. -->	0.322	0.386	0.377	-0.056	0.224

Insufficient data for meaningful correlation calculation

- Correlations between PM<sub>2.5</sub> and MODIS AOD are generally high (> 0.5) for all days and for the warm season
- Correlations are slightly higher in 2003 than in 2002
- Correlations for Oct-Dec are very low for all sites



## Conclusions

- On a given day, both  $PM_{2.5}$  and MODIS AOD show excellent between-site agreement across the Atlanta area.
- Day-to-day variations in  $PM_{2.5}$  and AOD are large but seasonal variations are small.
- MODIS AOD tracks the seasonal patterns of  $PM_{2.5}$ .
- MODIS AOD does not capture the day-to-day  $PM_{2.5}$  variability in fall and winter.
- Correlations between AOD and  $PM_{2.5}$  for the warm season are generally  $> 0.5$  for individual sites and for the means of all sites.



# HELIX ATLANTA



Bridging Health &  
Environment



[www.cdc.gov/nceh/tracking](http://www.cdc.gov/nceh/tracking)

