

PUBLIC HEALTH, AIR QUALITY, AND REMOTE SENSING

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Basics of Public Health

Public Health

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



Basics of Public Health

Epidemiology

- The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems.



Basics of Public Health

Public Health Approach

Problem

Surveillance:
What
is the
problem?

Risk Factor
Identification:
What is the
cause?

Intervention
Evaluation:
What
works?

Implementation:
How do you
do it?

Response



Basics of Public Health

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.



Basics of Public Health

Public Health Surveillance

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



Basics of Public Health

Surveillance Information Uses

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



The U.S. Center for Disease Control and Prevention's (CDC) National Environmental Public Health Tracking (EPHT) Program was 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*”

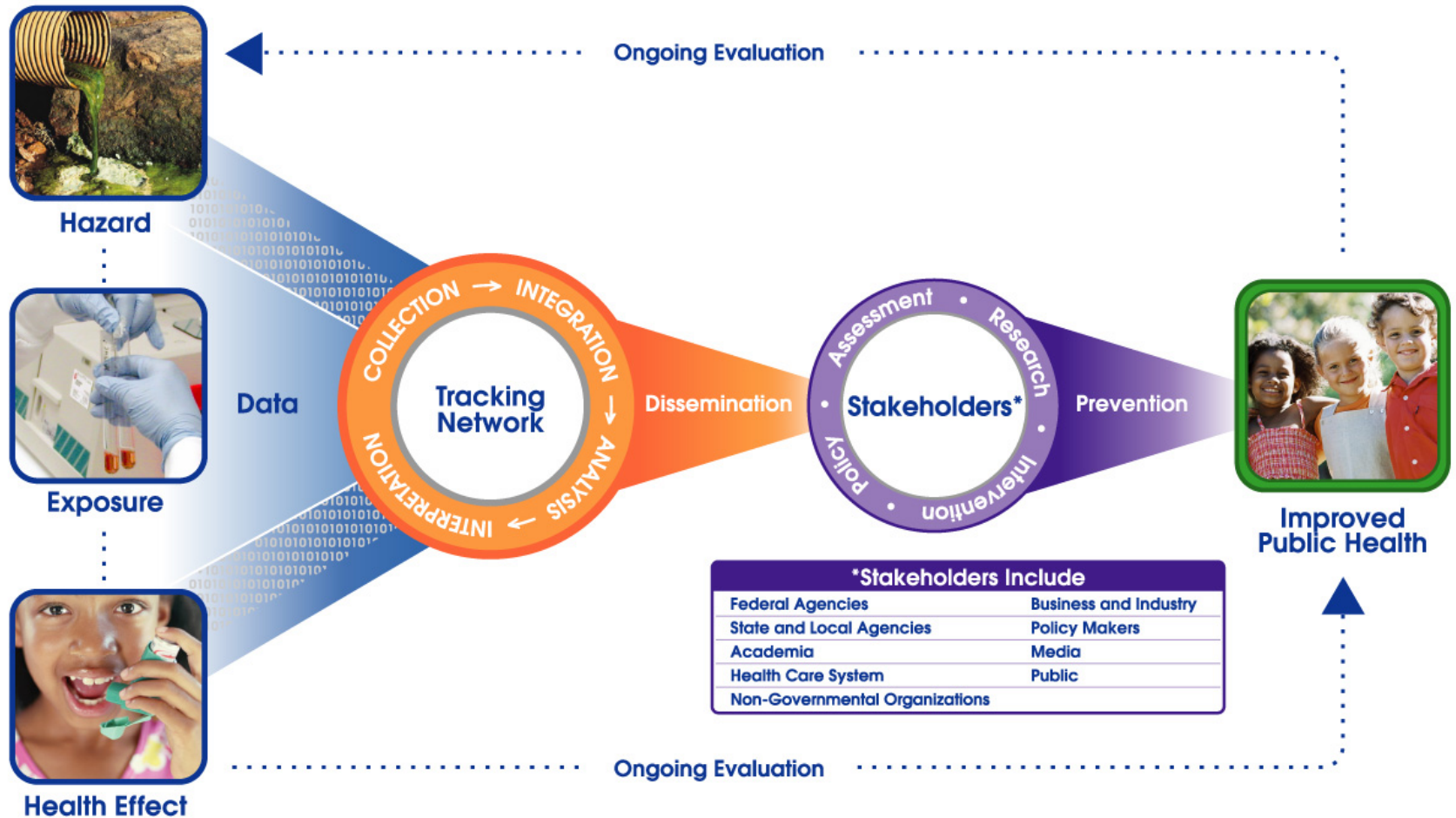


Tracking = Public Health Surveillance

- 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



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





PUBLIC HEALTH, AIR QUALITY, AND REMOTE SENSING

**THE INTEGRATION OF PUBLIC
HEALTH SURVEILLANCE, AIR
QUALITY ASSESSMENT, AND
REMOTE SENSING:**

AN ATLANTA, GEORGIA CASE STUDY



Health and Environment Linked for Information Exchange (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 Overview

- HELIX-Atlanta was developed to support current and future state and local EPHT programs to implement data linking demonstration projects which could be part of the EPHT Network.
- HELIX-Atlanta is a pilot linking project in Atlanta for CDC to learn about the challenges the states will encounter.
- NASA/MSFC and the CDC are partners in linking environmental and health data to enhance public health surveillance.
- The use of NASA technology creates value – added geospatial products from existing environmental data sources to facilitate public health linkages.
- Proving the feasibility of the approach is the main objective of this project



HELIX-Atlanta Respiratory Health Team

RH Team Pilot Data Linkage Project:

Link environmental data related to ground-level PM_{2.5} (NASA+EPA) with health data related to asthma

Goals:

1. Produce and share information on methods useful for integrating and analyzing data on asthma and PM_{2.5} for environmental public health surveillance.
2. Generate information and recommendations valuable to sustaining surveillance of asthma with PM_{2.5} in the Metro-Atlanta area.

Environmental Hazard Measure: Daily PM_{2.5}

Asthma Measure: Daily acute asthma office visits to KP-GA Medical Facilities

Time period: 2001-2003

Linkage Domain: 5-county metropolitan Atlanta



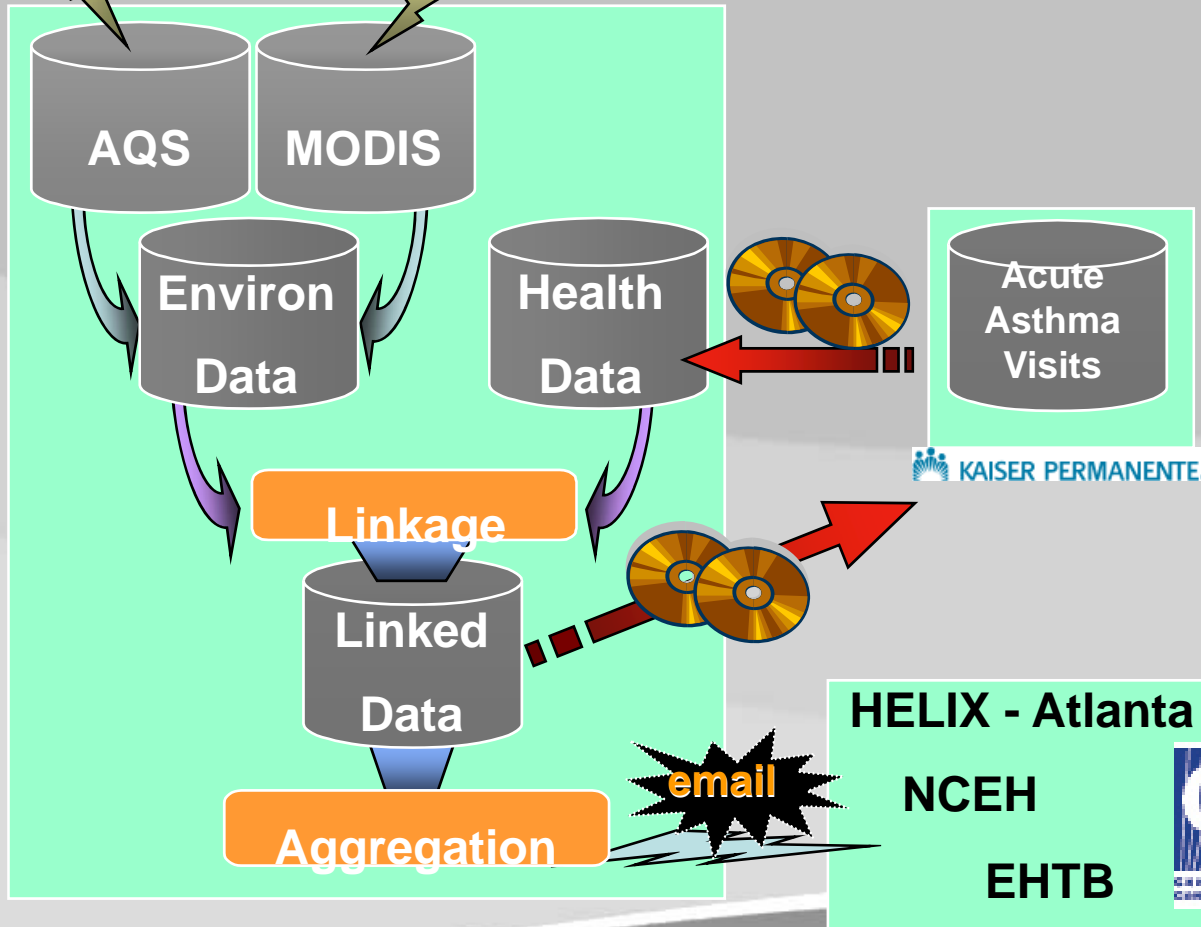
Data Linkage



EPA



NASA



HELIX - Atlanta Team

NCEH

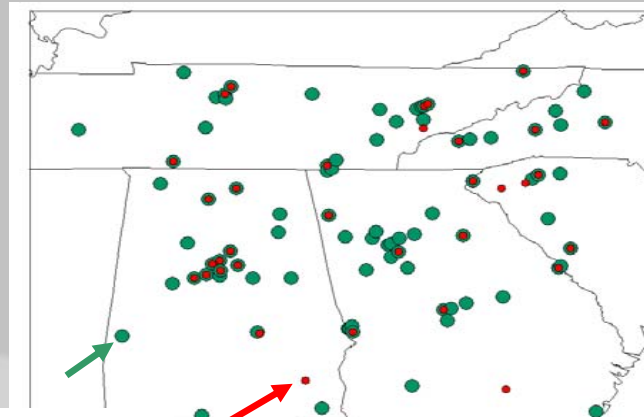
EHTB



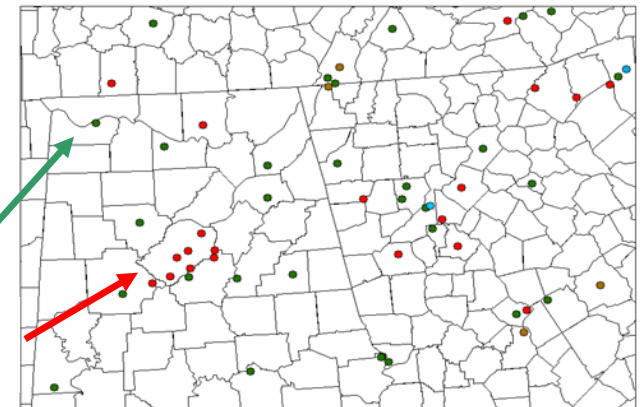
Sources of PM_{2.5} data: EPA AQS

EPA Air Quality System (AQS) ground measurements

- National network of air pollution monitors
- Concentrated in urban areas, fewer monitors in rural areas
- Time intervals range from 1 hr to 6 days (daily meas. every 6th day)
- Three monitor types:
 - Federal Reference Method (FRM)
 - Continuous
 - Speciation
- FRM is EPA-accepted standard method; processing time 4-6 weeks



FRM sites
Non-FRM sites



6-Day sites
Hourly sites

Legend

- Frequency=1hr
- Frequency=1day
- Frequency=3days
- Frequency=6days

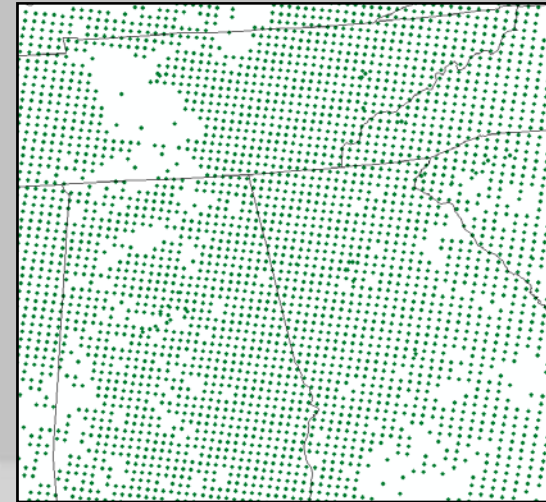
EPA AQS PM_{2.5} Reporting Monitors
on Jan 10, 2004



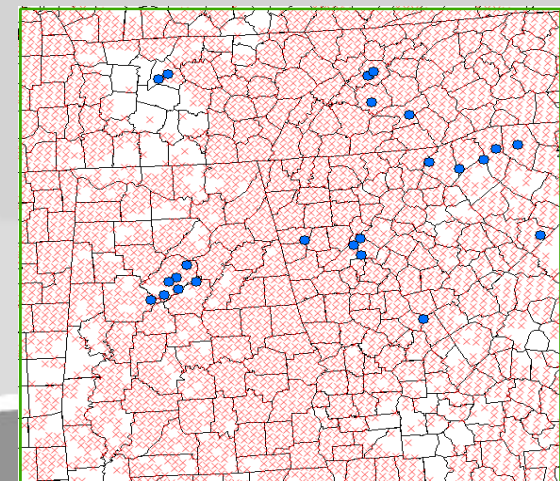
Sources of PM_{2.5} data: MODIS

MODIS Aerosol Optical Depth (AOD)

- AOD is a measure of the total particulate in the atmosphere
- If atmosphere is well mixed, AOD is a good indicator of surface PM_{2.5}
- Enhanced Spatial Coverage
- Provided on a 10x10 km grid
- Available twice per day
(Terra ~10:30 AM, Aqua ~1:30 PM)
- Clear-sky coverage only
- Available since spring 2000



MODIS



AQS



June 25, 2003

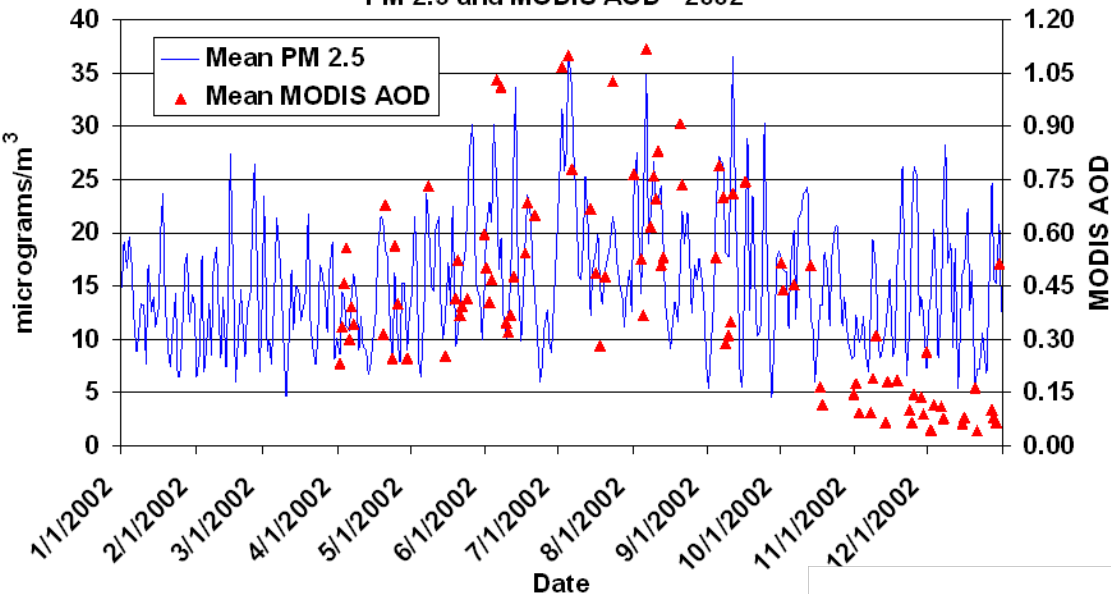
Estimating PM_{2.5} from MODIS data

- For 2002-2003, obtain MODIS AOD and EPA AQS PM_{2.5} data
- Extract AOD data for 5 AQS site locations
- Calculate daily averages from hourly AQS PM_{2.5} data
- Using daily PM_{2.5} averages from all 5 Atlanta AQS sites, determine statistical regression equations between PM_{2.5} and MODIS AOD
- Apply regression equations to estimate PM_{2.5} for each 10 km grid cell across region



MODIS AOD - PM_{2.5} Relationship

PM 2.5 and MODIS AOD - 2002

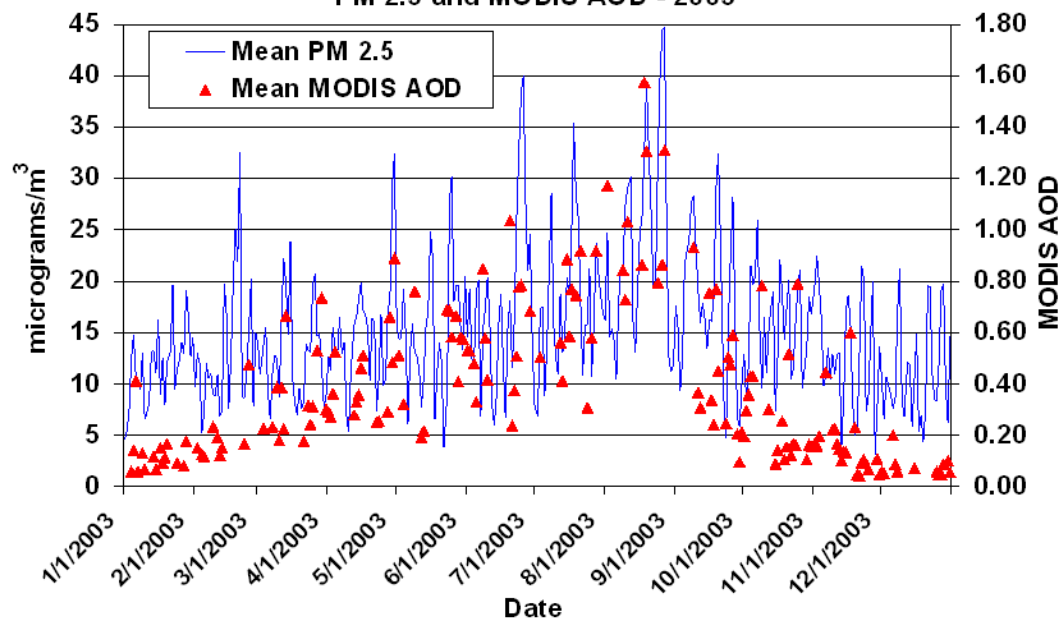


2002

2003

- Daily 5-site means of observed PM_{2.5} and MODIS AOD
- MODIS data not available every day due to cloud cover
- MODIS AOD follows seasonal patterns of PM_{2.5} but not the day-to-day variability in fall and winter

PM 2.5 and MODIS AOD - 2003



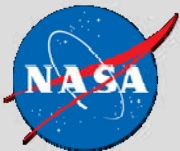
PM 2.5 – MODIS AOD Correlations

April - September

MODIS-Terra MODIS-Aqua

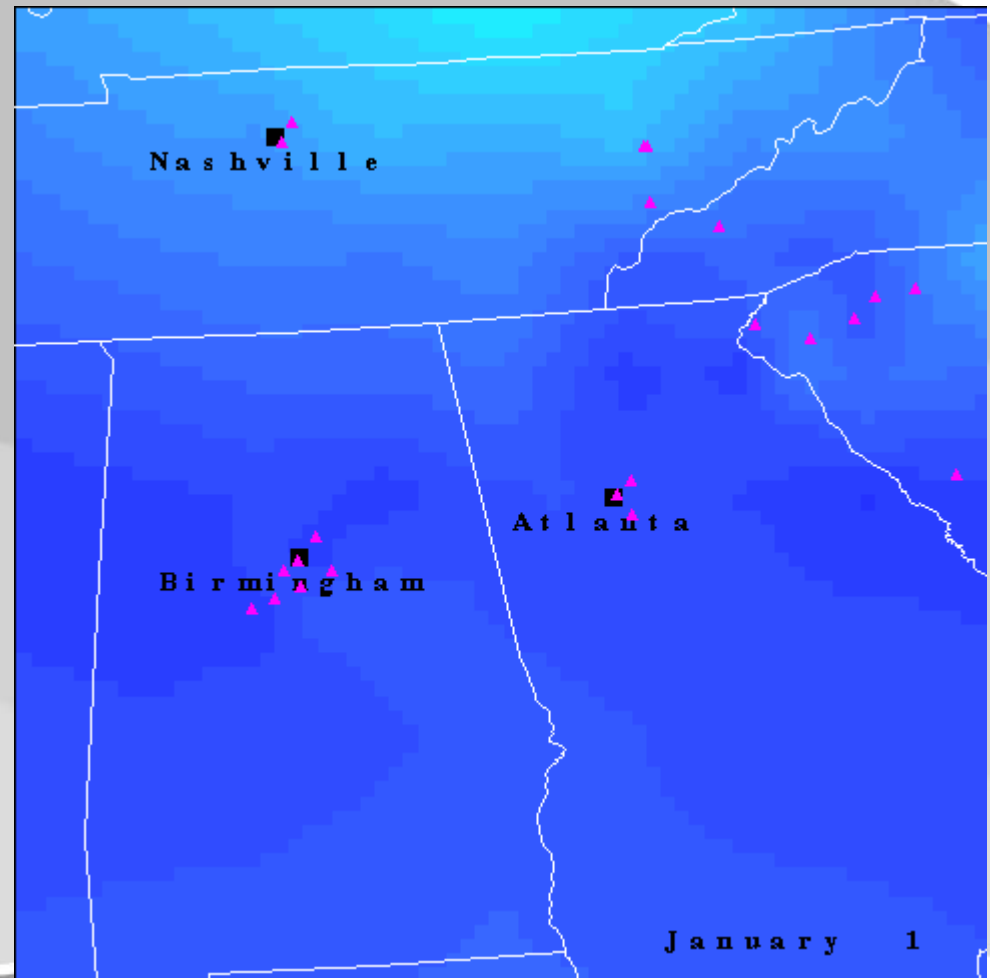
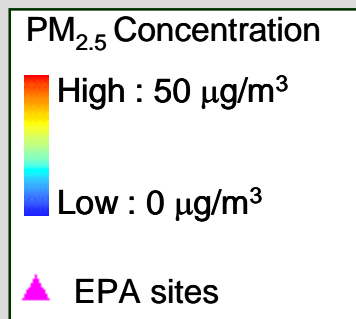
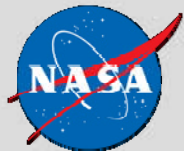
2000 -->	0.579	
2001 -->	0.643	
2002 -->	0.559	0.401
2003 -->	0.661	0.727

- Correlations between PM_{2.5} and MODIS AOD are generally high (> 0.55) for the warm season.
- The lower correlation for MODIS-Aqua in 2002 is for July-September only.



PM_{2.5} Exposure Assessment- Spatial Surfacing

- 1st degree recursive B-spline in x- and y-directions
- Inverse Distance Weighted (IDW)
- Daily surfaces created on a 10x10 km grid
- Variable number of measurements available each day

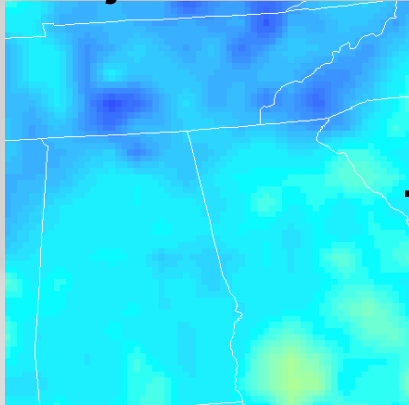


Merging MODIS and AQS PM_{2.5} Data

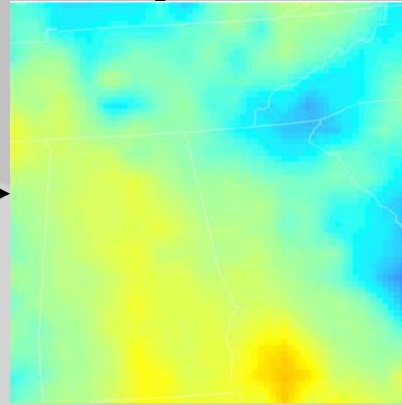
- MODIS and AQS data have been merged to produce final PM_{2.5} surfaces.

B-Spline Surfacing

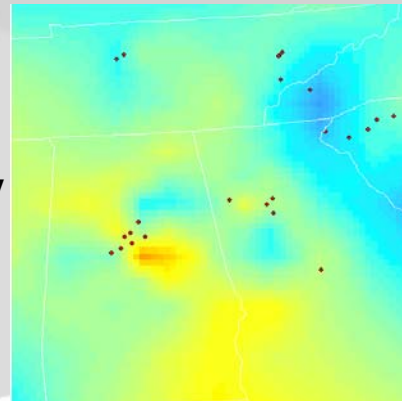
Unadjusted MODIS



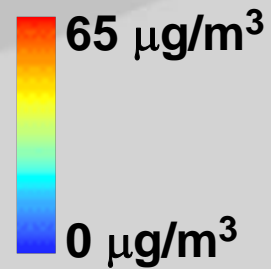
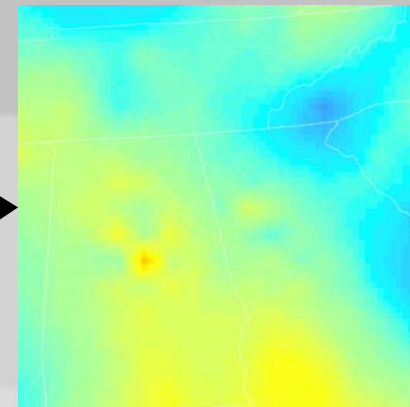
Bias-adjusted MODIS



AQS only



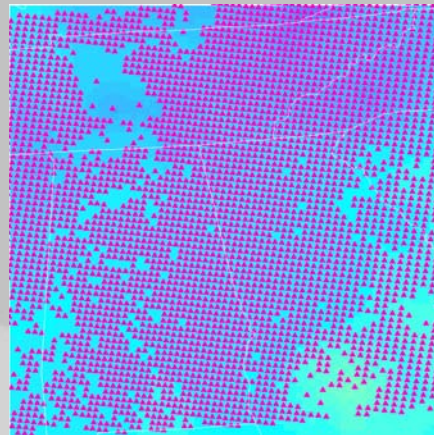
Merged



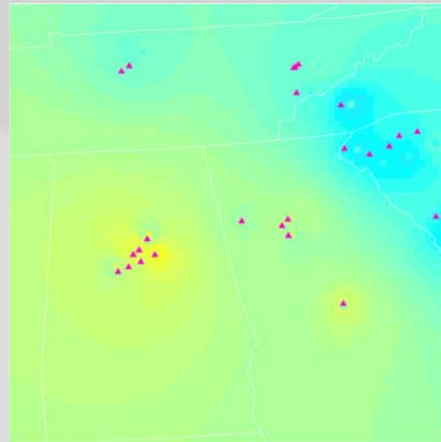
Merging MODIS and AQS PM_{2.5} Data

IDW Surfacing

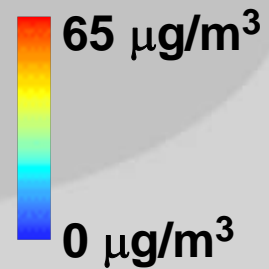
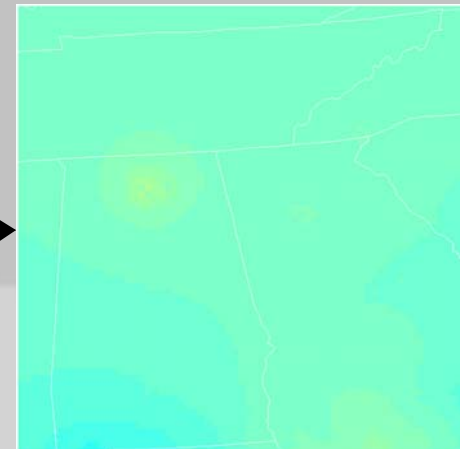
MODIS Only



AQS only

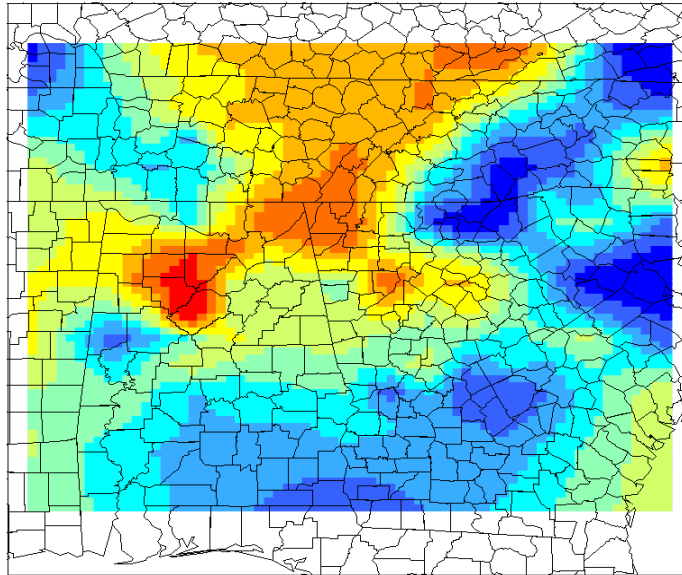


Merged

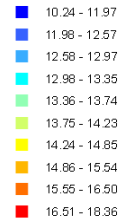


Annual Composite Surfaces

PM2.5 B-Spline Surfaces Year 2003 Composite

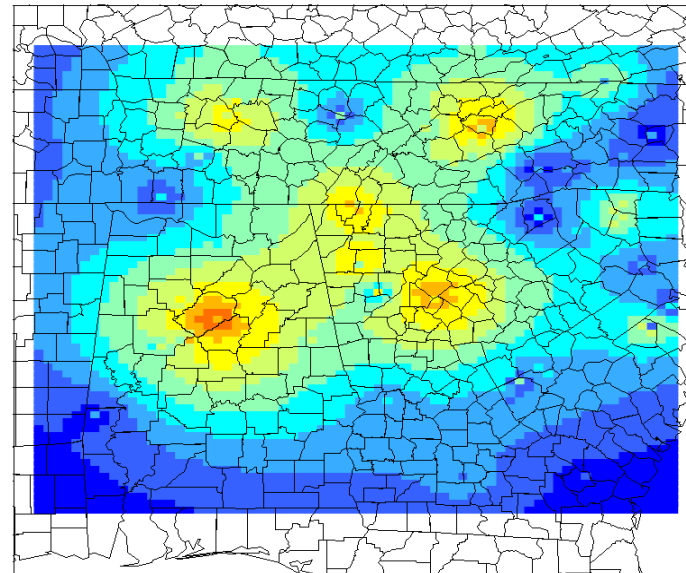


PM2.5 ($\mu\text{g}/\text{m}^3$)

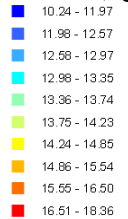


B-Spline

PM2.5 IDW Surfaces Year 2003 Composite



PM2.5 ($\mu\text{g}/\text{m}^3$)



IDW



Linkage of Environmental and Health Data

Health Data Set

Members

LON	LAT	ID	AGE	GENDER	YEAR/MO
-84.207	99.200	1	Child	M	200301
-84.802	99.359	2	Adult	M	200301
-83.798	99.993	4	Child	F	200301

Acute asthma office visits

ID	AGE	LON	LAT	GENDER	DATE
1811	Child	-84.179	99.118	F	1/1/2003
54767	Adult	-84.625	99.802	F	1/1/2003
84580	Adult	-84.679	99.691	F	1/1/2003

*Simulated Data Set. F=female, M=male, A=adult, C=child.



Linkage of Environmental and Health Data

Data Linkage Outputs

Visit counts by grid cell

Date	Cell	PM2.5	FC	MC	FA	MA
200301	1	21.74	1	0	2	0
200301	2	12.79	0	0	0	0
200301	3	12.21	0	1	0	1

PM_{2.5} for each visit

Date	ID	Member	Lat/Lon	Cell	Cell Lat/Lon	County	State	Gender	Age	PM2.5
1	1	1811	99.572 -84.251	1944	99.552 -84.284	Coweta	GA	F	Child	21.74
1	2	15299	99.063 -83.860	1608	99.104 -83.806	Upson	GA	F	Child	12.79
1	2	15879	99.727 -84.369	2079	99.731 -84.403	Fulton	GA	M	Child	12.21

*Simulated Data Set. F=female, M=male, A=adult, C=child.



The background of the slide features a space-themed illustration. At the top left, a portion of the Earth is visible, showing blue oceans and white clouds. To its right, the Moon is shown in a dark, cratered state. Further right, the reddish surface of Mars is visible, with a white polar ice cap. The background is a deep red and orange nebula, with numerous small white stars scattered throughout. A large, white, curved shape, resembling a stylized 'C' or a protective shield, frames the central text area.

www.cdc.gov/nceh/tracking







Hong Kong, November 2006

REMOTE SENSING AND PUBLIC HEALTH ISSUES IN HONG KONG

HONG KONG MUST CUT POLLUTION TO ATTRACT FOREIGN CASH

HONG KONG (AFP) — Hong Kong must take drastic action to slash pollution to keep attracting foreign investors and protect public health, a new study released Monday said.

The city should follow the examples of Los Angeles and London, which have reaped the benefits from tougher emission targets and innovative anti-pollution measures, the Civic Exchange, a leading think-tank, said in a report.

"Air pollution has become the most serious environmental problem for Hong Kong, affecting not only public health but also the city's ability to attract and retain foreign investment," the study said.

"There is an urgent need to devise and implement a comprehensive air quality action plan to improve Hong Kong's air quality."



REMOTE SENSING AND PUBLIC HEALTH ISSUES IN HONG KONG

- **Air Quality: Impact of PM_{2.5} on respiratory and cardiovascular health in metropolitan Hong Kong**
- **Remote sensing of PM, precipitation, wind, and ozone from mainland China**
- **Impact on populations at risk; i.e., elderly, very young in relation to geographic location and socio-economic characteristics**
- **Other environmental impacts on public health? (e.g., benzene as a carcinogen in relation to where people live?)**
- **Infectious disease? (e.g., SAR?)**

