Public Health Air Surveillance Evaluation

Identifying

Evaluating

Public Health Air Surveillance Evaluation

Developing

Delivering
Part IA - CDC
Public Health Air Surveillance Evaluation

A Multi-Agency, Multi-Discipline Collaboration

Wisconsin
- Routinely Available Air Characterization Data
  - Ozone & Particulate Matter
  - Compatible w/Hosp. Disc. & ED Data
    - Asthma
    - Cardiovascular Disease

- How to Guide (Cookbook)
  - Case Definitions
  - Other Risk Factors
  - Confounders/Covariates
  - Analysis Software

- Lessons Learned
  - Scientific & Technical
  - Multi-Agency, Multi-Disciplined Collaboration
Background
EPHT Hazard Data Determined by:

- Health Effect of Interest
- Characteristics of Health Effect Data
- Type Exposure (Acute vs Chronic)
- Desired Public Health Action
Identifying Data Sets for EPHT

Desirable Characteristics:

- Ongoing, Systematic Collection
- Available for Most States
- Std Collection/Reporting
- QA/QC Procedures
- Temporal & Spatial Variables
- Fine Resolution of Data
- Timely Availability
- Related to Human Exposures
Ozone & PM Air Monitoring Data

- Desirable Characteristics
- Significant Limitations
  - Spatial Gaps
  - Temporal Gap
Perception

Ozone AQI Values by site on 06/20/2003

Source: EPA's Air Explorer (http://www.epa.gov/airexplorer)

AIR.

ALL THE CARCINOGENS OF CIGARETTES...
...NONE OF THE FIX
Reality

August 1999 Base Case

8/1/99 PPB
EPA PARTICIPATION IN PHASE

Question: Best Method for Generating Air Data Useful for Assessing the Health Status of All Populations?
STATE PARTICIPATION

Criteria:
– Air Project in Work Plan
– Initial Measures Identified
– Northeastern State
– At Least 1 Part A State
– Request for CDC Assistance
New York State Request
Interpolation Methods?
Wisconsin Request
Satellite Data?

June 23
MODIS Sensor aboard the Terra Satellite Captures a PM Transport Event in June 2002. High Aerosol Optical Depth over upper mid-West moves East, then out to the Atlantic Ocean.
Maine Question
Part IB - EPA
PHASE Panel Discussion: Characterizing Air Quality for Environmental Public Health Tracking

CDC’s Second Annual Environmental Public Health Tracking Conference

April 22, 2005

Timothy Watkins

US EPA’s Office of Research and Development
Overview of Presentation

- Brief overview of EPA’s perspective
- What air quality data are available?
- How do these data compare?
EPA’s Mission

• “To protect human health and to safeguard the natural environment — air, water, and land — upon which life depends.”

• How do we measure our effectiveness?
Indicators

Data Available

Level 1
Actions by EPA, State, and other regulatory agencies

Level 2
Actions and behavioral changes by regulated community

Level 3
Reduced amount or toxicity of emissions

Level 4
Improved ambient conditions

Level 5
Reduced exposure or body burden

Level 6
Improved Human or ecological health

Data Unavailable at present Time

Output Measures

Measures of Human/Eco-Health

RESEARCH & DEVELOPMENT
Building a scientific foundation for sound environmental decisions
Questions remain about the impact of EPA Activities on Public Health

- Detroit News (May 7, 2000)
  - An evaluation of EPA’s first 30 years
  - “Air and Water are cleaner, but health gains unclear”

- EPA Draft Report on the Environment
  - “There is a need for measures to compare actual and predicted human health and ecological effects related to exposure to air pollutants.”

- National Research Council
  - Recommendation: “Develop and implement a system to assess and monitor human health and welfare effects through the identification of indicators capable of characterizing and tracking the effects of air pollutants”

- Health Effects Institute
  - RFA – “Measuring the Health Impact of Actions Taken to Improve Air Quality”
Sources of Air Quality Characterization Data

- Ambient Air Monitoring
- Air Quality Modeling
- Satellite Data
Ambient Air Monitoring

PM 2.5 Monitors

- “True” measure of air quality
- Spatial gaps - rural areas have few sites
- Temporal quality varies – hourly to weekly
- Routinely available information
Example Ozone and PM Ambient Monitoring Data

Ozone AQI Values by site on 07/18/2004

PM2.5 AQI Values by site on 07/18/2004

* Good
* Moderate
* Unhealthy for Sensitive Groups
* Unhealthy
* Very Unhealthy

Source: EPA's Air Explorer (http://www.epa.gov/airtrends)
Generated on: EPAERES
Air Quality Modeling

- Estimate of air quality
- Good spatial and temporal coverage
- Air Quality Forecasting
  - Emerging source of routine data
Satellite Data

- Emerging source of data
- Spatial and Temporal Gaps
  - Cloud cover
  - Reflective surfaces
- Potential new source of routinely available data
  - Additional work needed
The Role of Statistics

• Statistical techniques can be used to fill in the spatial and temporal monitoring gaps
• Statistical techniques have mostly relied solely on ambient monitors
  ▪ We statistically interpolated with “Kriging”
• New statistical techniques “combine” ambient monitoring and emerging sources of data (e.g., satellite, modeling)
  ▪ Capitalize on the strengths of each data source while minimizing the weaknesses
  ▪ Provide a sense of uncertainty
  ▪ We used Hierarchical Baysian (HB) technique
Combining Air Quality Data
July 21, 2001 Ozone Levels:
Kriging vs Combined Data (CMAQ and Observations)
Ambient vs. Personal Exposure

- Methods estimate ambient concentrations, but . . .
- People experience health impacts from the air they breathe (i.e., their personal exposure)
- How do the outputs from the various air quality characterization methods relate to personal exposure?
Initial Observations
On
Air Quality Data
Air Quality Data

- Daily estimates are provided for type of data for 2001.
  - Particulate matter2.5 (daily mean) - many temporally interpolated day
  - Ozone (daily 8 hour maximum) – most in the ozone season

- Different scales (depending on data type)
  - 4, 12, 36 KM grids
## Preliminary Qualitative Comparison of Air Quality Characterization Data

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Ambient data</th>
<th>CMAQ</th>
<th>Statistically Interpolated Surface</th>
<th>Hierarchical Baysian Surface</th>
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<tbody>
<tr>
<td>Ease of delivery</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>M</td>
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<tr>
<td>Spatial coverage</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Temporal coverage</td>
<td>M</td>
<td>H</td>
<td>M+</td>
<td>M-H</td>
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<tr>
<td>Match ambient data</td>
<td>H</td>
<td>M</td>
<td>M-H</td>
<td>M-H</td>
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<tr>
<td>Resource Requirements</td>
<td>L</td>
<td>H</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>Strength of relationship to exposure and health data</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>
Comparative Maps:

- Maps used to illustrate …
  - Spatial differences in spatial resolution/patterns
  - Difference in “error” estimates
  - “Odd” results
  - Improvement seen by combining measured and modeled data
Daily PM$_{2.5}$ Concentration (ug/m$^3$) Sept. 12, 2001
EPA FRM Monitoring Data and CMAQ
Combined PM$_{2.5}$ (ug/m$^3$) Surface, Sept. 12, 2001
Summary

- EPA is seeking better ways to measure the success of its programs.
  - Demonstrate impact on public health
- Environmental Public Health Tracking (EPHT) is seeking compatible air quality data to inform public health actions.
- There are new possibilities for improving the way we characterize air quality.
- These new approaches may improve our ability to understand relationships between air quality and public health.
- The PHASE Project is evaluating these new approaches and their potential application to EPHT air issues.
Acknowledgements

• Fred Dimmick, EPA ORD
• Dave Holland, EPA ORD
• Lee Tooly, EPA OAR
• Terence Fitz-Simons, EPA OAR
• David Mintz, EPA OAR
• Bill Cox, EPA OAR
• Ellen Baldridge, EPA OAR
What Health Effects?

- Asthma
  - Biological Plausibility
  - Association – Research Literature
  - Significant Morbidity – Children
  - Priority in all 3 States

- Cardiovascular Disease
How did you link data?

- **NYS**
  - Geocoded Residential Address
  - GIS Assigned to Grid
  - Ungeocodable Protocol

- **ME & WI**
  - Zip Code Level Data
  - Population Weighted Centroids

- Evaluating Impacts of Scale
  - 36, 12, 4km
ZIP Codes and Air Quality Grids
How did you assess the association?

**Case-crossover analysis**

Case-crossover analysis compares exposure before case event to exposure at referent times, in the same individuals.

Why? To use individual-level info.
How did you assess the association?

Case-crossover: advantages

- only need case information
- matched design
- exposure assignment to individual
- can study interactions
- simple to use
- drawbacks? sure…
What are you after?
It’s Surveillance!

- *not* about establishing cause-effect
- tracking association over time and place

What for?
- check on interventions
- check on regulations
- look for vulnerable subpopulations
How were you doing this before PHASE?

Pre-PHASE Plan (Maine)
Pre-PHASE?

Maine

Add a monitor!
Pre-PHASE?

IDW

Kriging

NYS
Pre-PHASE?

Wisconsin

2010 Goals

Hospital Admissions

Air Contaminant Levels

2000

2010

Low

High
Post-PHASE?

Wisconsin

2010 Goals

Exposure to Air Contaminant Y in Cases of Health Effect X
post-PHASE plan

Estimate ambient air quality at resolution of health data

Maine

Ambient monitoring interpolated to zipcode centroids using kriging. Source: EPA OAQPS, EMAD.
post-PHASE plan

Maine

Link to zipcode of patient residence

ED Visits 2001 Portland
What can you do now?

- Single Indicator
- Compare Across States
- Increased Credibility
- Assess Rural Communities
- Focus Resources
  - Health Data
  - Analysis Methods

 ★ Issue - Confidentiality of Health Data
Obstacles & Opportunities

- Analytical Challenges
  - 4 sets air char. data & monitoring data
  - 4 resolutions air data
  - Several lag times
  - Different referent periods
  - Cultural Barrier
Obstacles & Opportunities

- MOU
- Data Sharing Agreements
- Building Trust
- Snowballing Efforts
- Expectations
Post-PHASE

- Standardized Linkage Methods
- Indicator Development & Utilization
- Common Analysis Method
- Multi-state Comparisons
Obstacles & Opportunities - EPA

- Developing new air quality characterization techniques
- Skepticism about air quality models
- Understanding strengths and limitations of health data
- Educating health departments about air quality data
- Internal coordination among different expertise (monitoring, models, and statistics)
Sustainability

- Routinely Available Air Characterization Data
  - Ozone & Particulate Matter
  - Compatible w/Hosp. Disc. & ED Data
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- How to Guide (Cookbook)
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VISION – Data & Results Comparable
Sustainability

- Resources to generate air quality data
  - Depends greatly on method

- Supporting EPA Interests
  - Tracking health endpoints of interest
  - Providing information to measure and evaluate effectiveness of policies/regulations

- Development of IT tools to facilitate data transfer/exchange