Looking for Associations between Air Quality and Health

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MPCA Presentation
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Overview

- EPA grant
- Sources of health and air quality data
- Issues of assigning exposure value
- Two methods of analysis we are using
- Preliminary results
- Odds ratio and attributable fraction
- Other areas for analysis

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U.S. EPA STAR Grant (R833627010)

- Local initiatives and national policies expected to reduce emissions of air pollutants
  - Unique opportunity to measure impacts on population exposure and association with health outcomes

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EPA STAR Grant

- Develop and evaluate outcome-based environmental health indicators
  - 8 year study period (2002-2009)
  - Statistical models used to track health effects associated with changes in air quality

Two Study Populations

- Twin Cities Seven County Metro
- Olmsted County

Health Outcome Data

- **Hospitalizations**
  - Asthma
  - Chronic Lower Respiratory Disease
  - Total Respiratory Disease
  - Cardiovascular Disease
- **Mortality**
  - Cardiopulmonary Disease
  - All Causes

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Air Quality Data

- ✶ $PM_{2.5}$
  - – Monitored data
    - • 1 in 3 and 1 in 6 days
    - • 24 hour continuous (hourly)
  - – Modeled data
    - • Emissions model
    - • Hierarchical Bayesian model
- ✶ Ozone
- ✶ Speciated $PM_{2.5}$
  - – Sulfates, nitrates, carbon

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Air Quality data choice issues

- ★ Need to assign population exposure

- ★ 4 sources of $PM_{2.5}$
  - 1 in 3 and 1 in 6 days
  - 24 hour continuous (hourly)
  - Emissions model
  - Hierarchical Bayesian model

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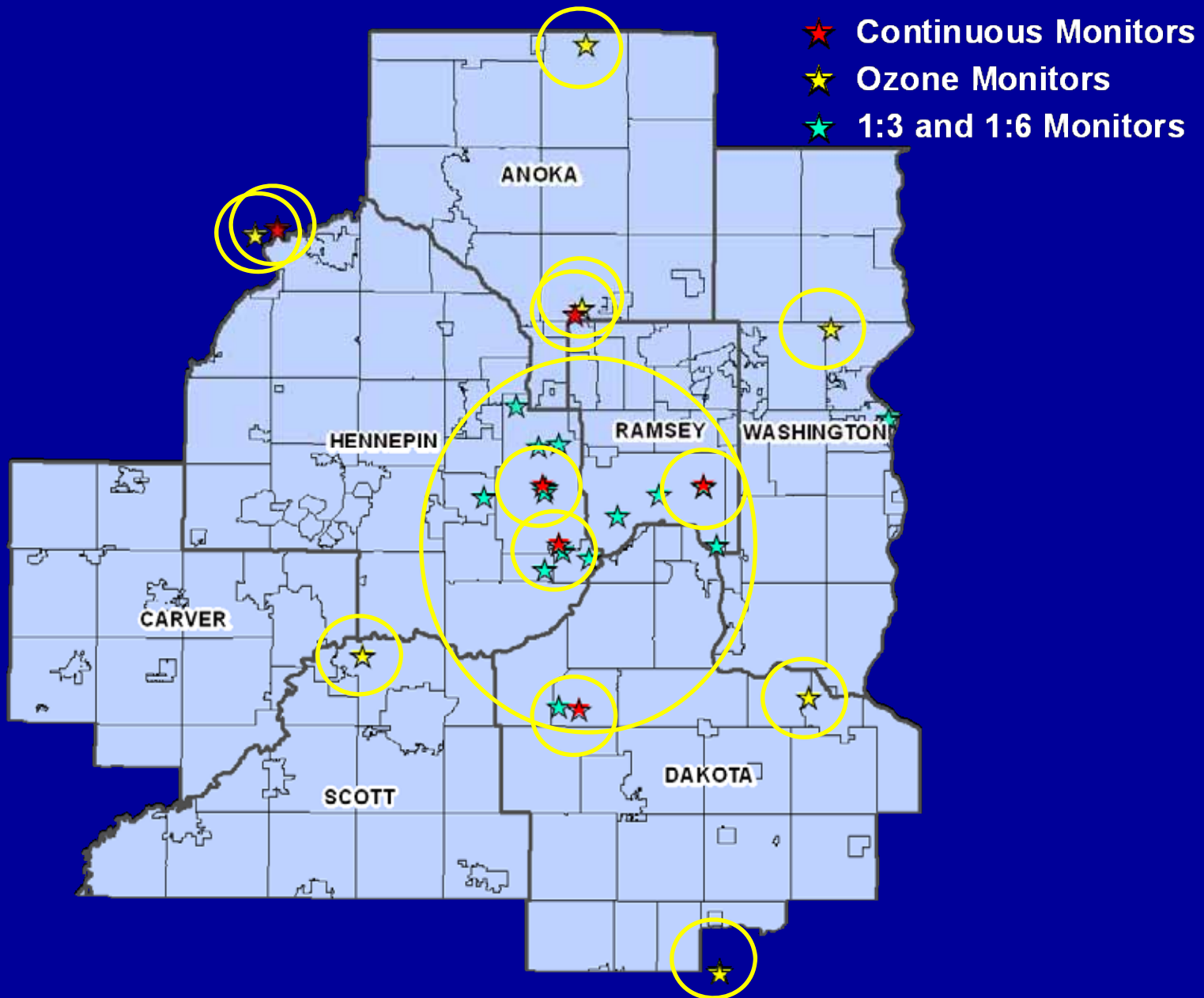
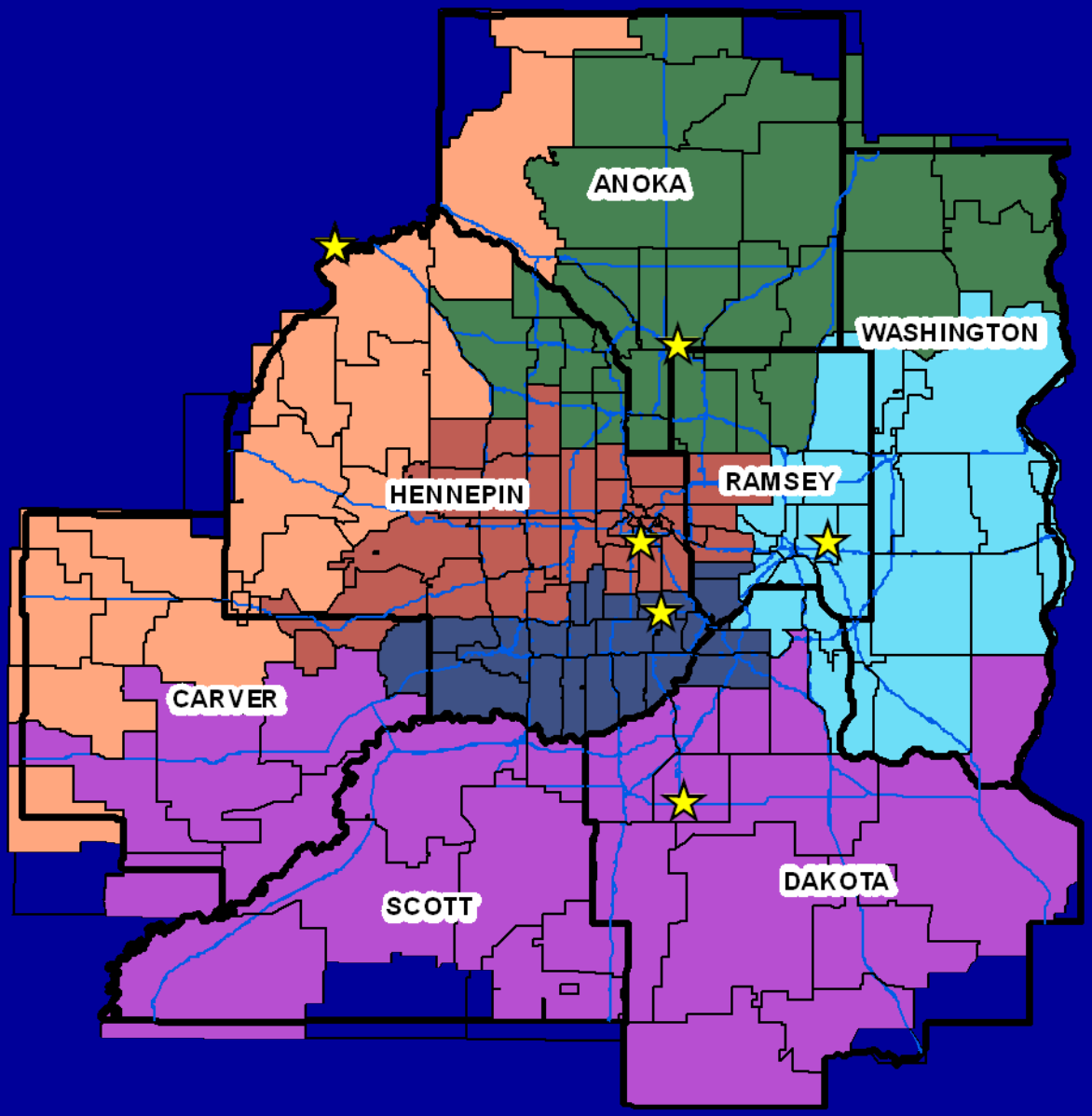
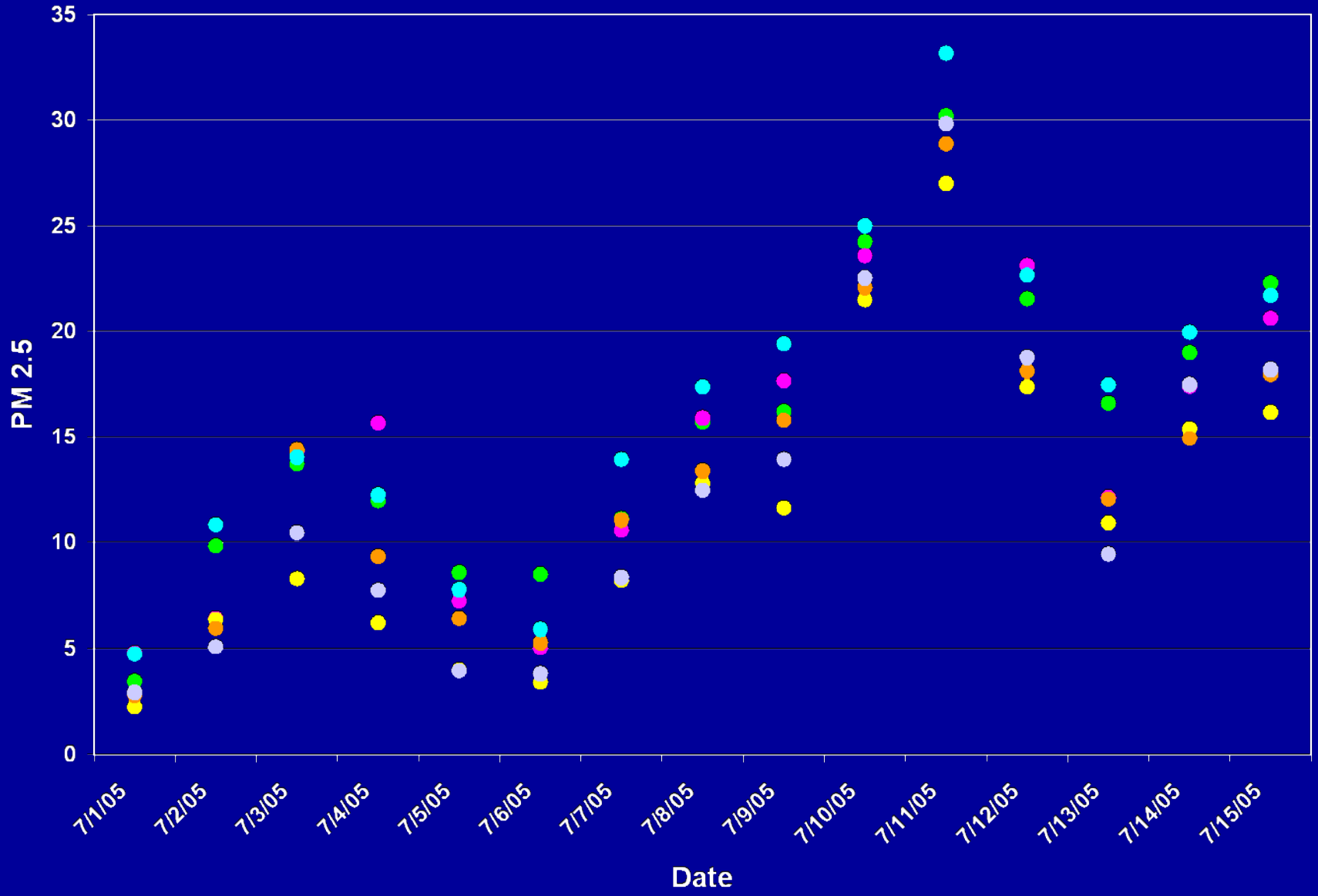
Monitor Locations- 7 County Metro



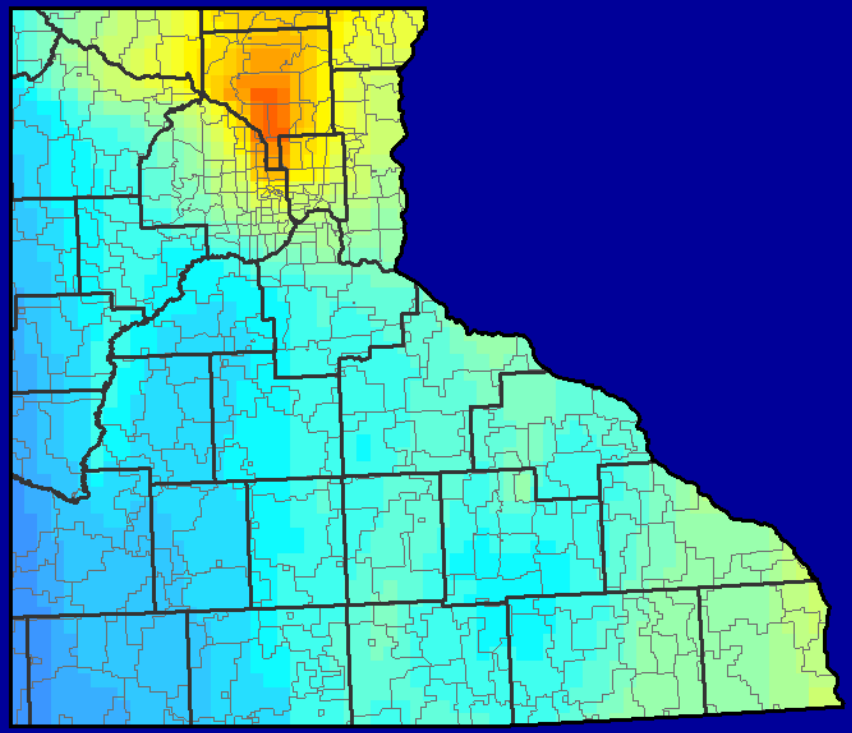
Closest Monitor to Zip Code Centroid

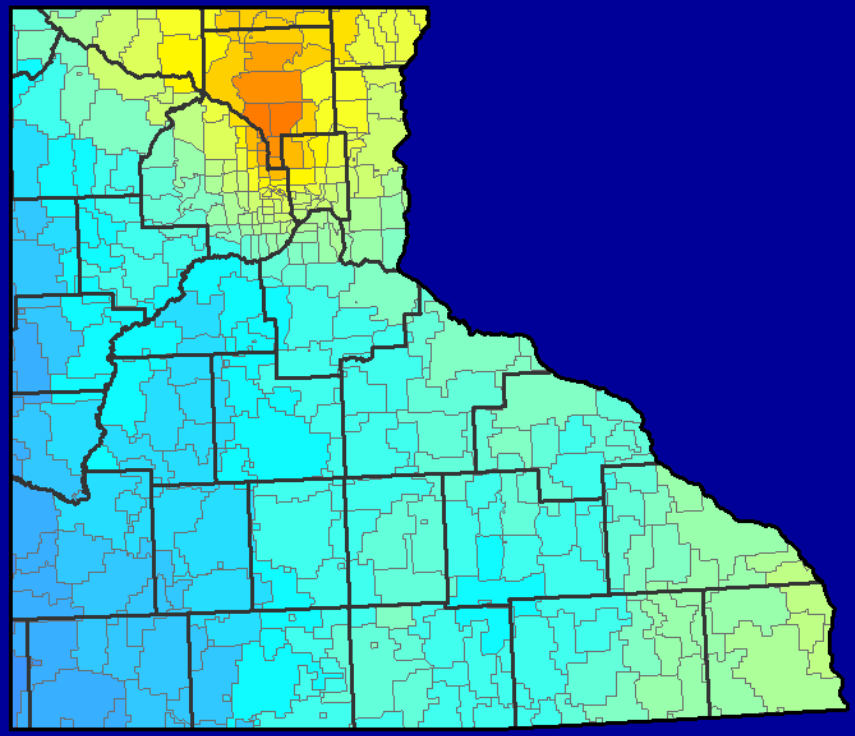


Monitor Spatial Variation



Emissions model data





4 km grid

Zip code level

PM2.5 Concentration
(ug/m3)

Hierarchical Bayesian modeled data

- Combines monitored and modeled data
- More weight is given to data where monitors are located
- Very complex statistical modeling
- Requires significant computer resources

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What measure do we use?

- PM is a regional pollutant
- For initial analyses, use one average value for the 7 county area
- Previous studies used one value for entire city exposure
- May represent individual patterns of exposure

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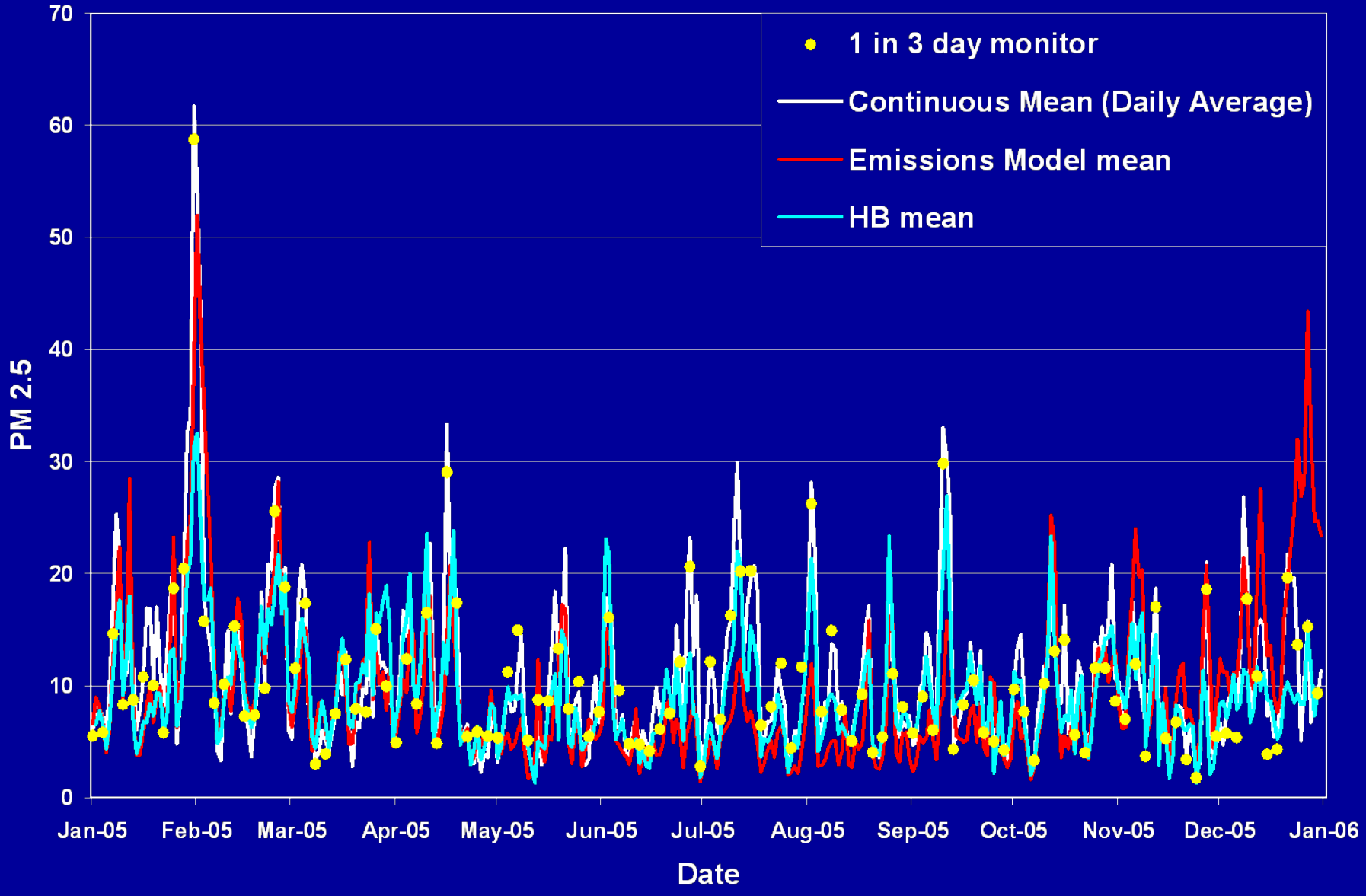
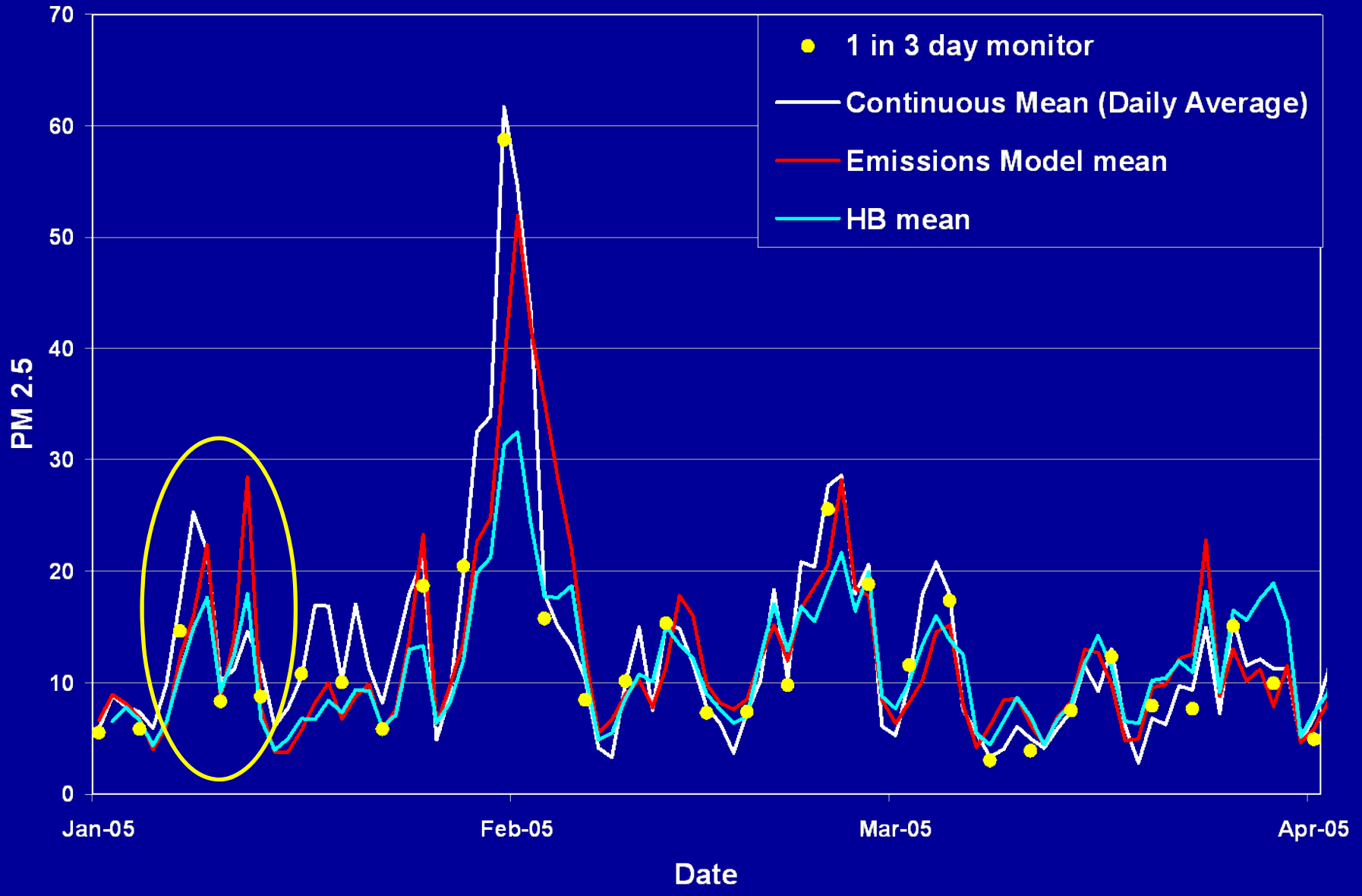
Air Data Source Comparison-2005



January-March 2005



Statistical Methods for Analysis

- Time Series-Poisson model
- Case-Crossover analysis

Time Series Analysis

- Daily counts of adverse events modeled against daily air quality values over time
- Need to control for time trends, seasonality and correlated data
- Covariates
  - Temperature, humidity, holidays, flu epidemics, day of the week
- No individual level data are used

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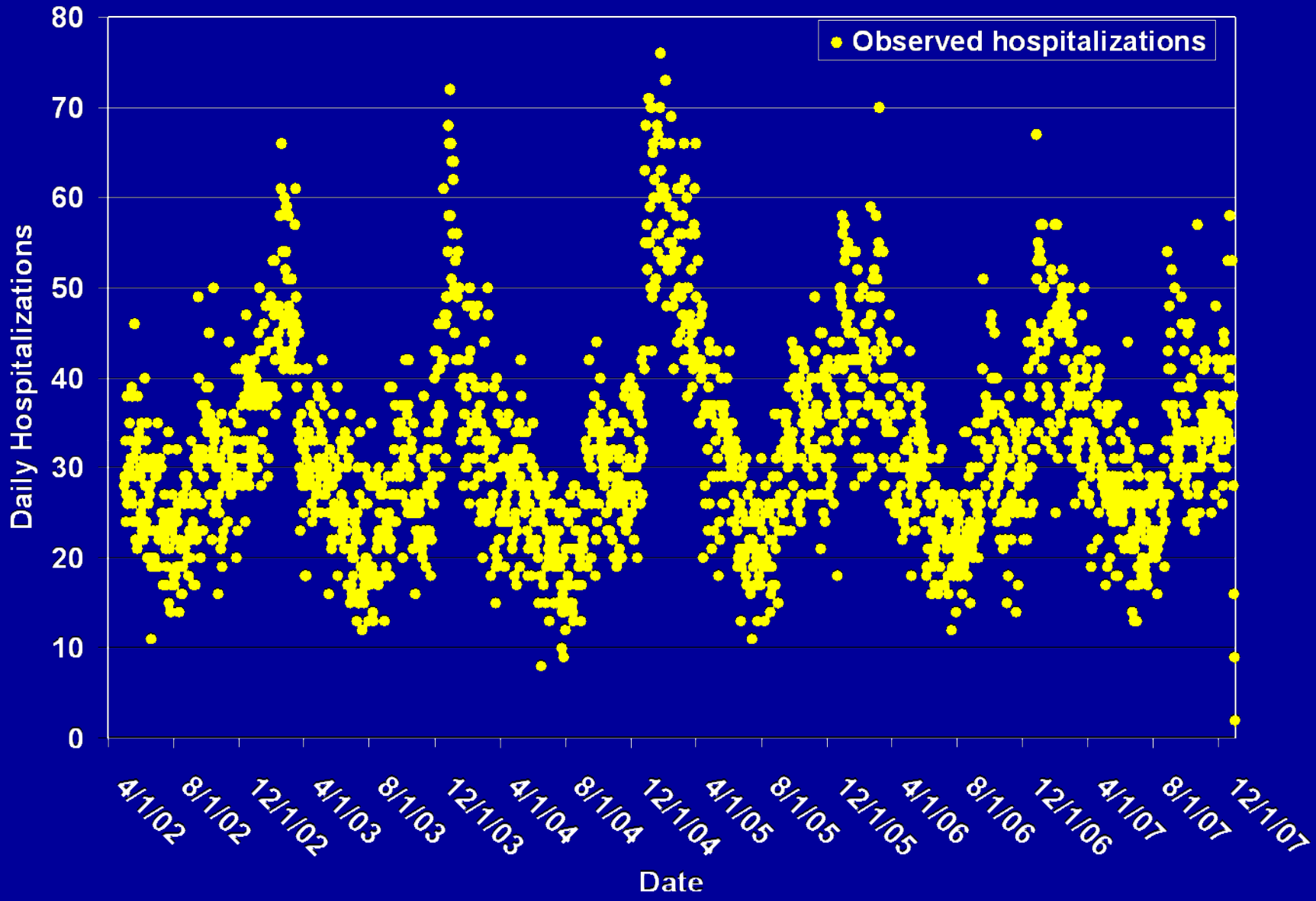
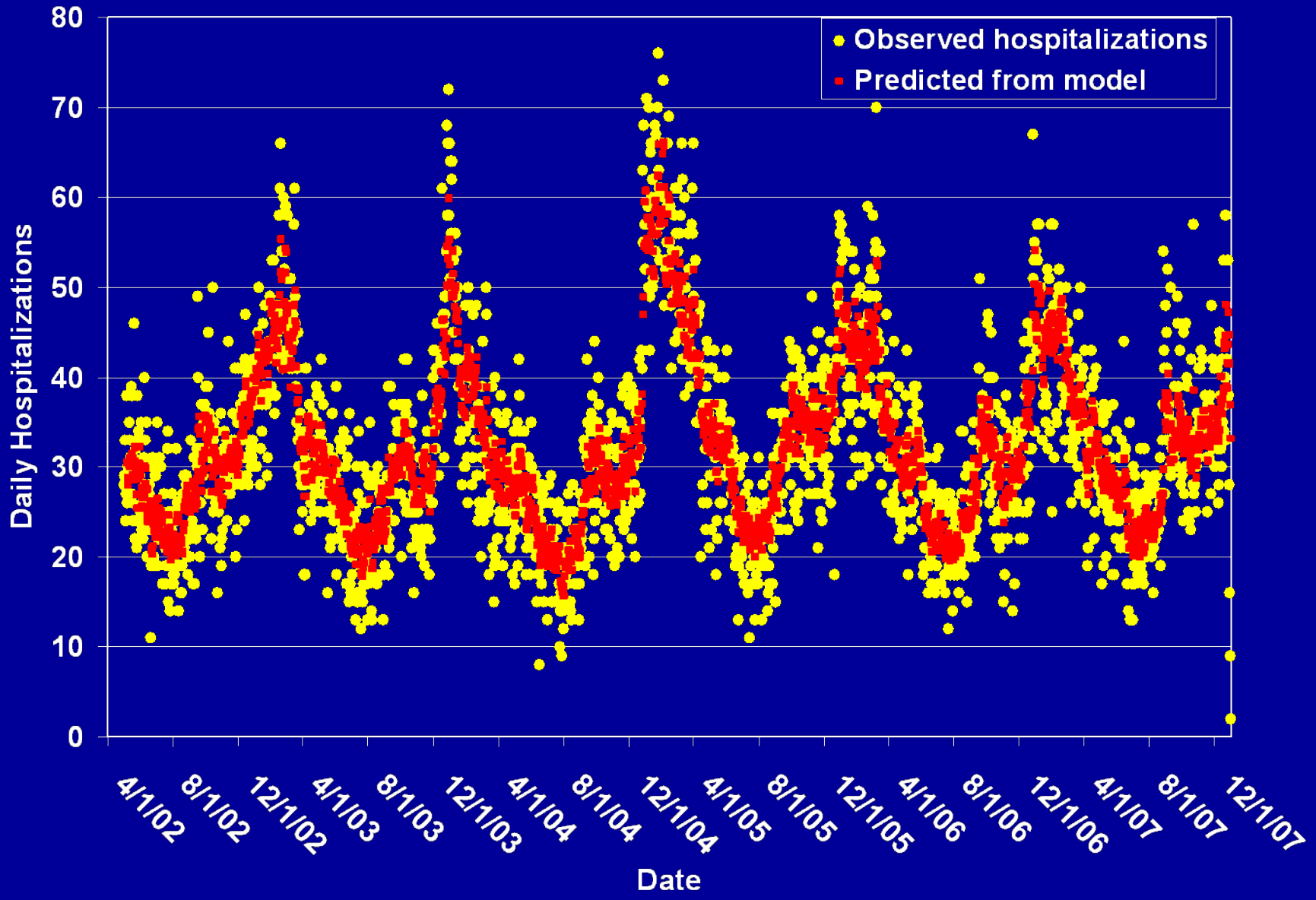
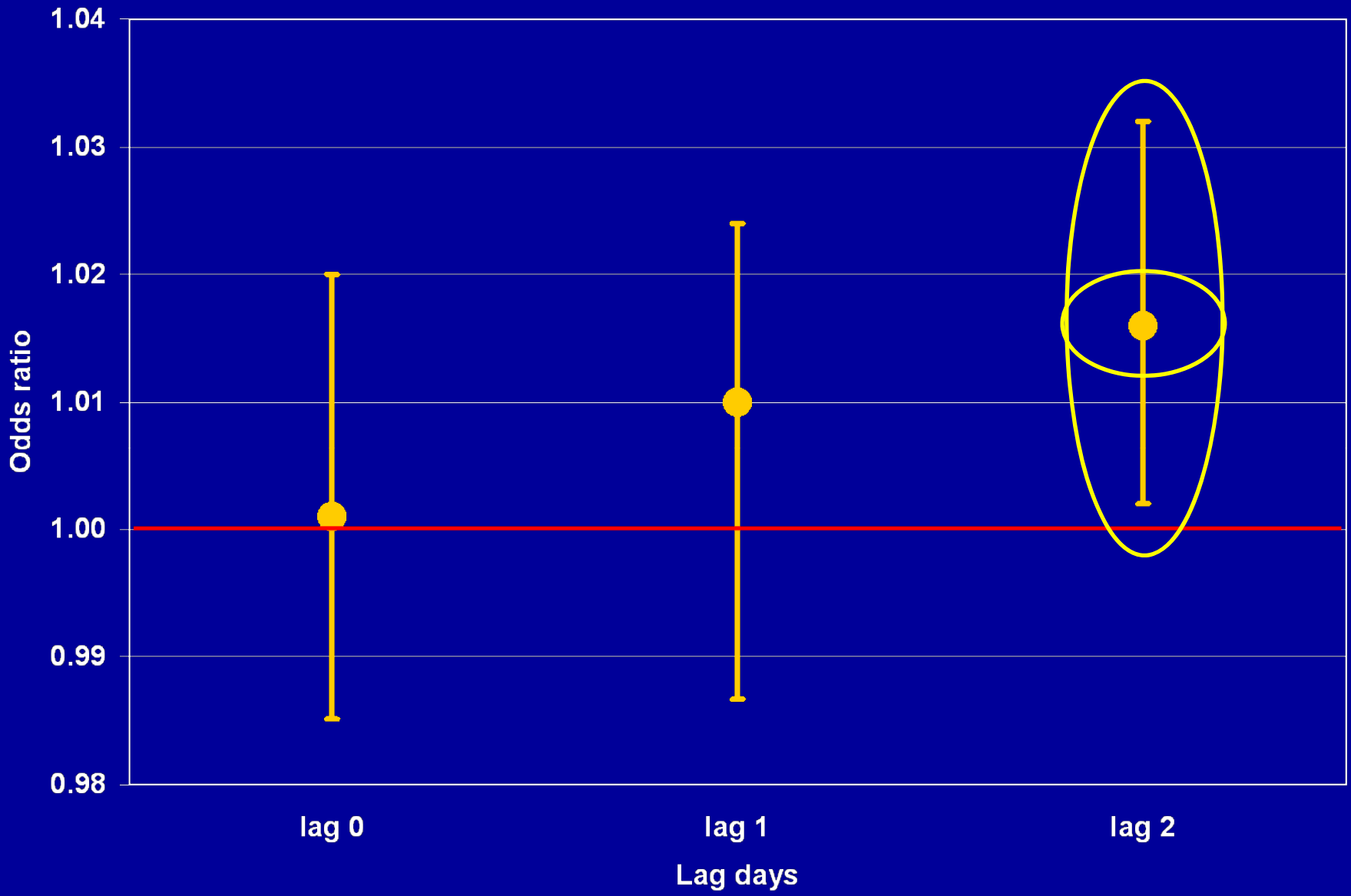
Total Respiratory Time Series results



Total Respiratory Time Series results



Total Respiratory Time Series results



Case-Crossover Analysis

- Modification of Case Control analysis
- Cases serve as their own control
  - Controls for individual factors
    - Smoking status, age, race, gender, occupation, other health conditions

Case-Crossover Analysis

- Relies on choice of referent time and lag structure
- Model is less complex than time series
- Individual level data is used
  - Can be used as effect modifiers
  - Gender, Age group

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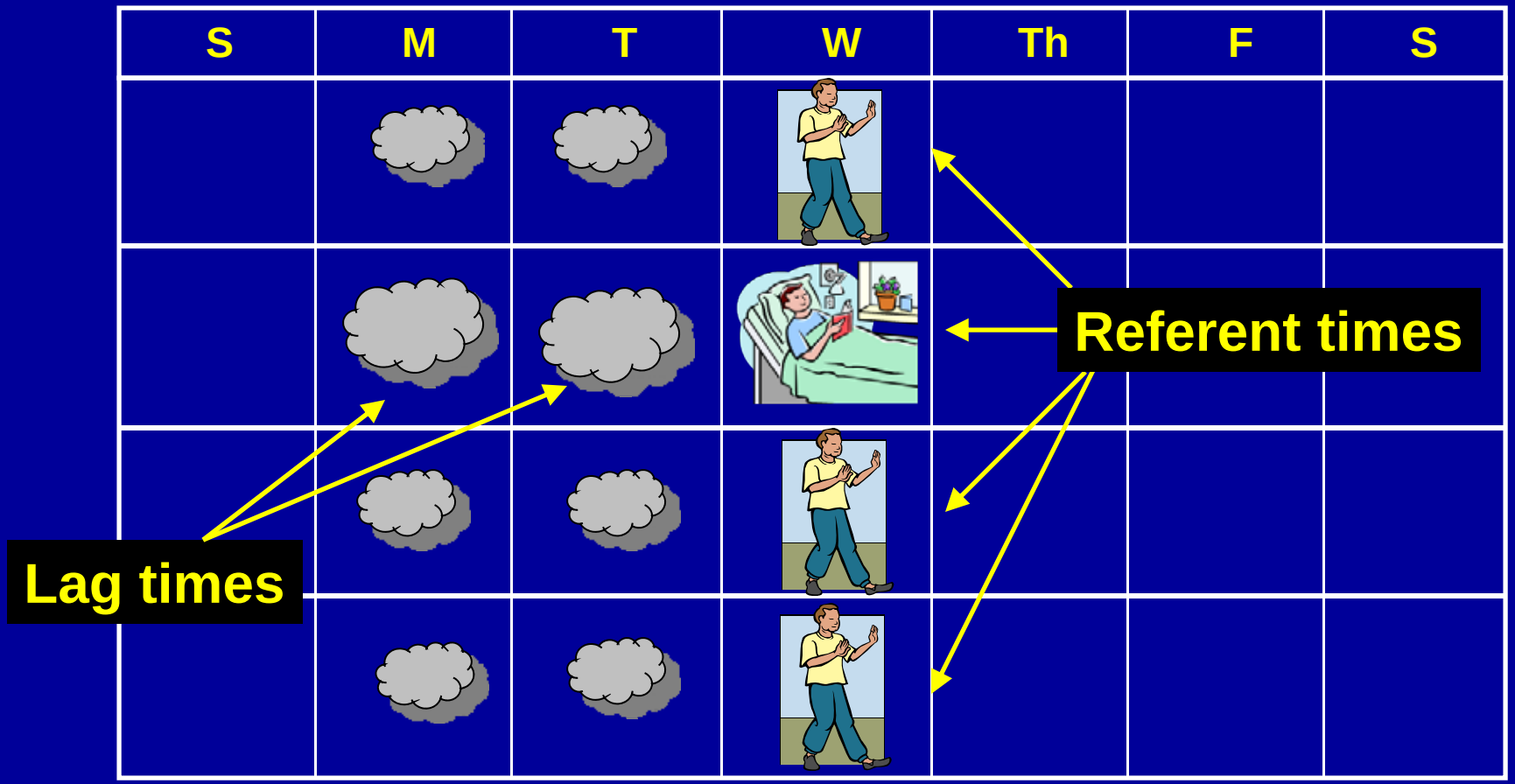
Case-Crossover Analysis

- Open source software program available through CDC EPHT program
  - Case-crossover analysis tool (C-CAT)

Referent time and lag structure



Choice of Lag Day Structure

- ★ Possible lag structures
  - – Individual days
    - lag0, lag1, lag2…
  - – Average lags
    - Average of lag0, lag1 and lag2
  - – Cumulative lags
    - Sum of lag0, lag1 and lag2
- ★ Driven by clinical evidence
- ★ Chosen by modeling strategy

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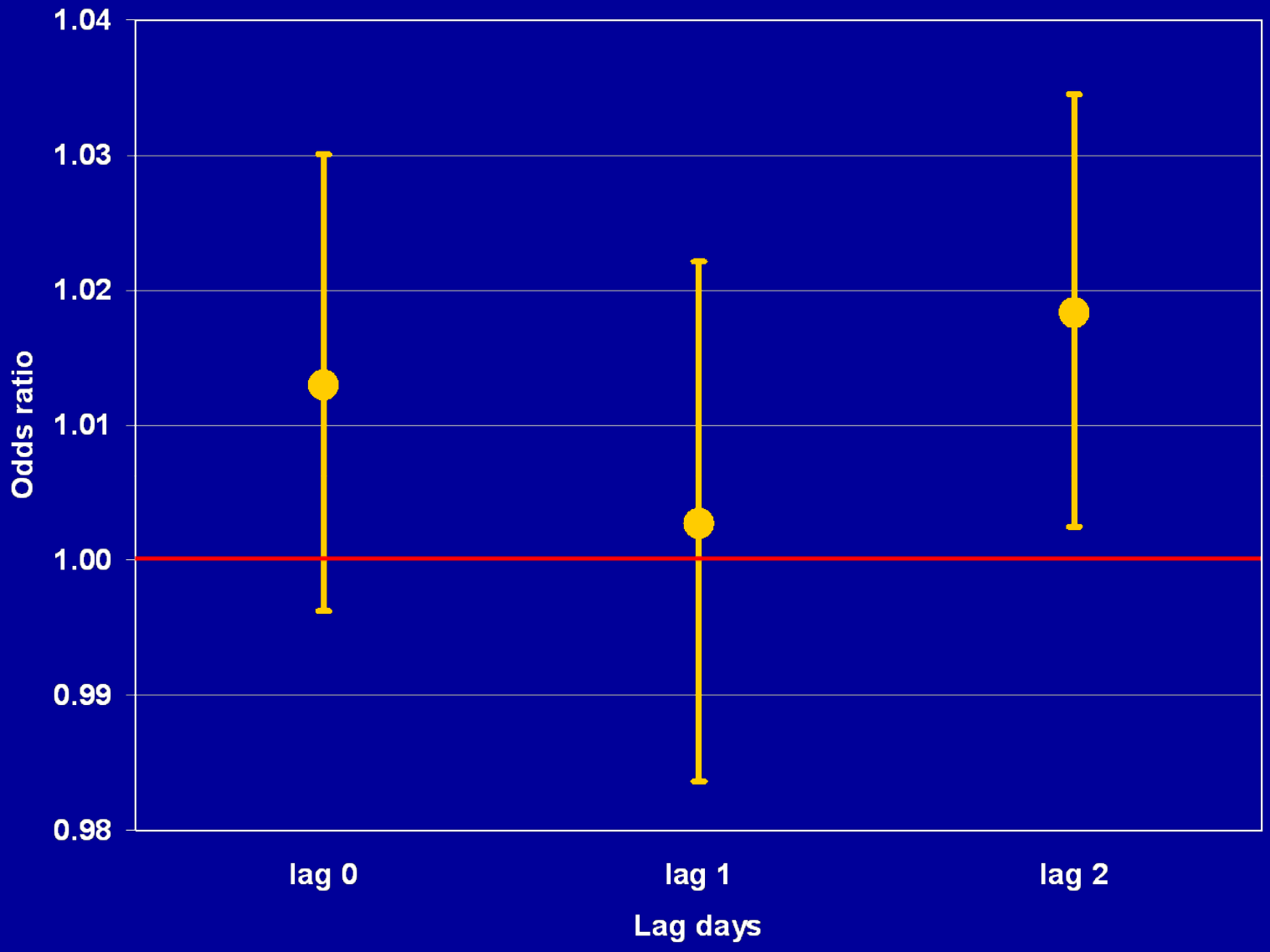
Case-Crossover results



Population Attributable Fraction

- Proportion of the disease in a population that would be eliminated if the exposure to the risk factor were eliminated
- Assuming the exposure causes the outcome
- Needs an estimate of pollutant level that would exist if there were no man-made emissions in the US

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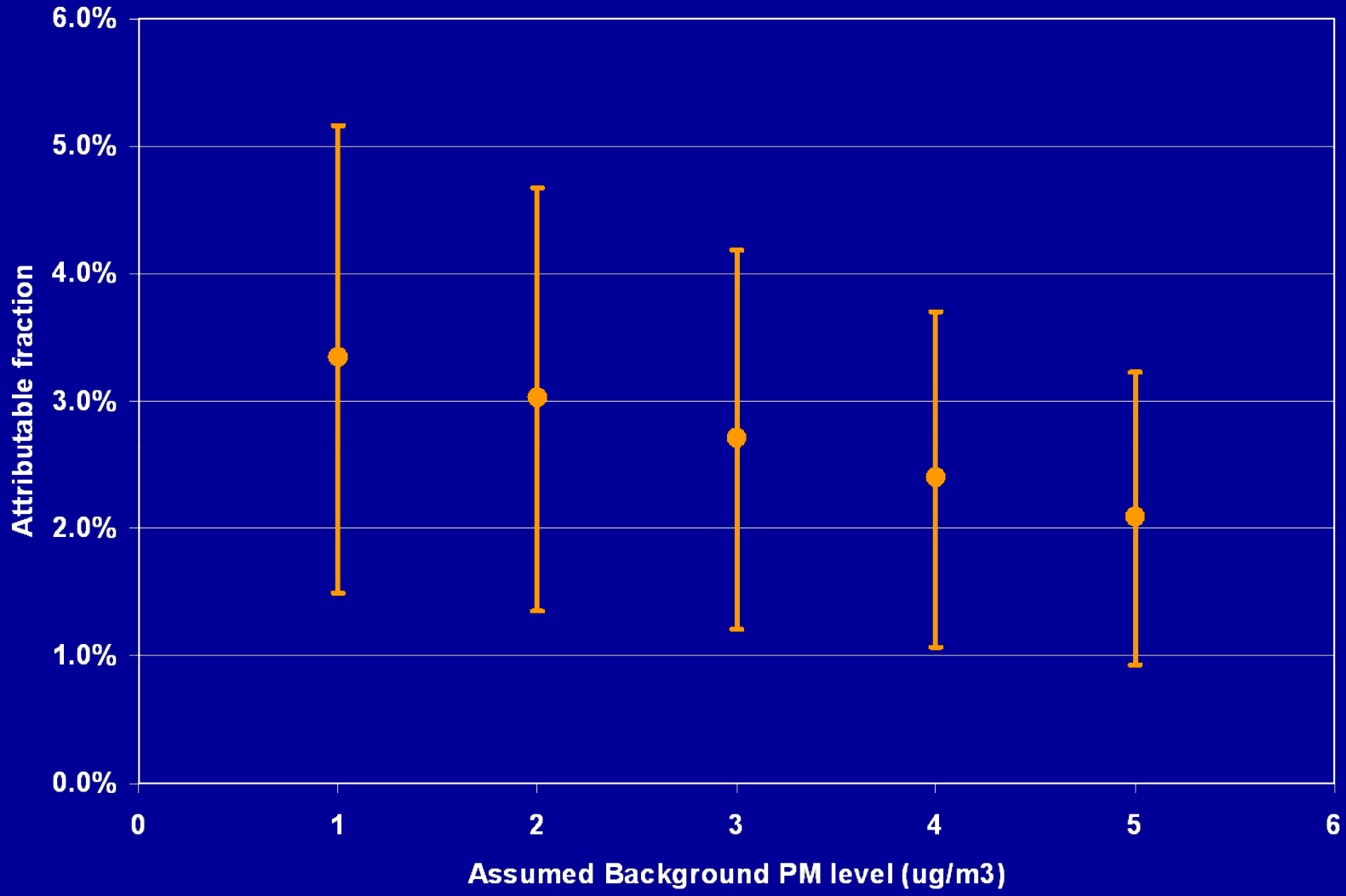
Attributable Fraction results



Directions for future analyses

- Spatially assigned air data
- Other pollutants (PM_{10}, ozone)
- Traffic data
- Ambulance data
- Pediatric vs. Adult
- Seasonal data (ozone)
- Pollen
- Noise

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Directions for future analyses

- Rochester Epidemiology Project
  - Asthma data
  - Clinic visit clusters
  - Prescription data for exacerbation
  - Geocoded data for better exposure assignment
- Speciated $PM_{2.5}$ monitor

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