

Looking for Associations between Air Quality and Health

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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**

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**

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

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}**

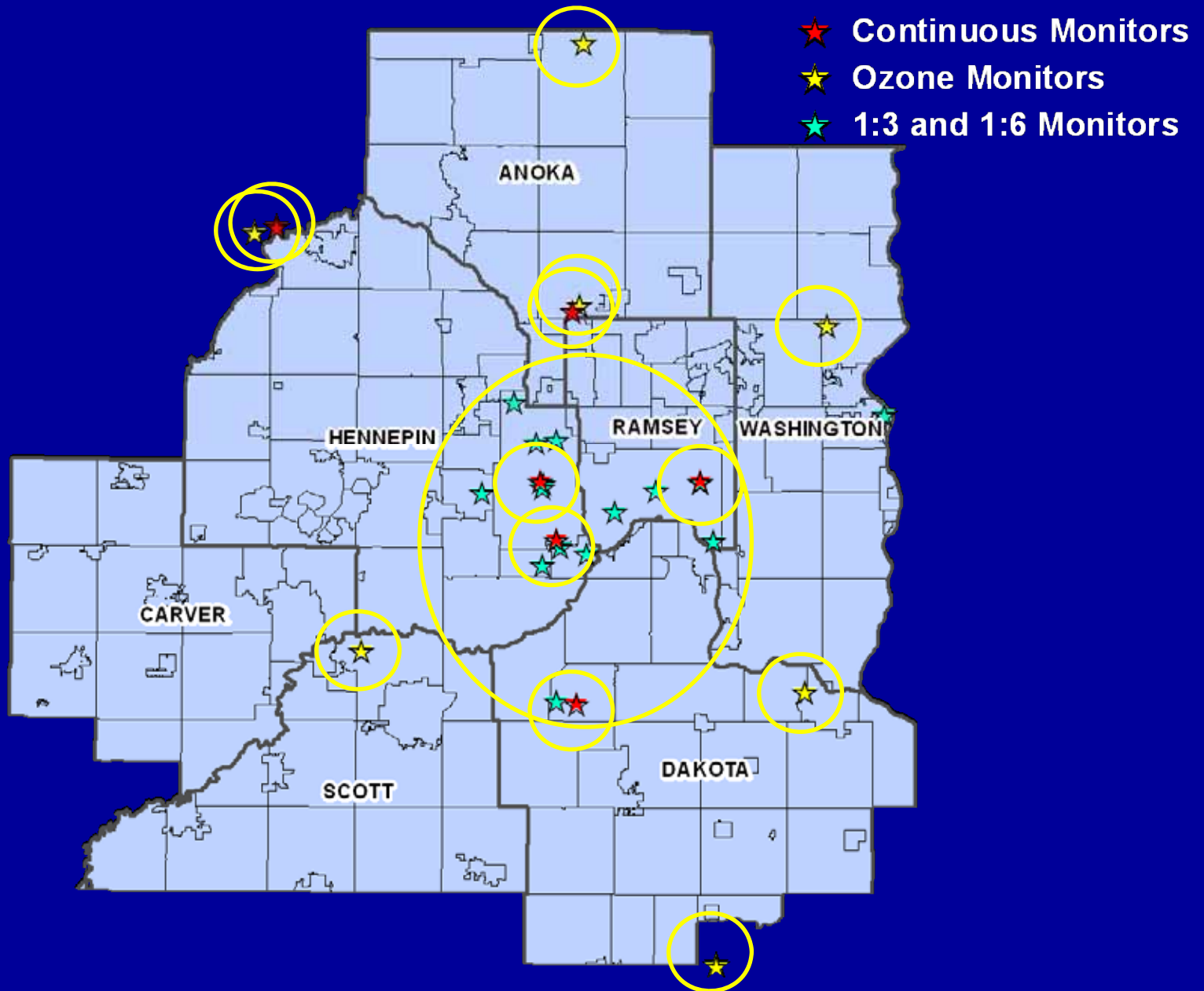
- ### – Sulfates, nitrates, carbon

Air Quality data choice issues

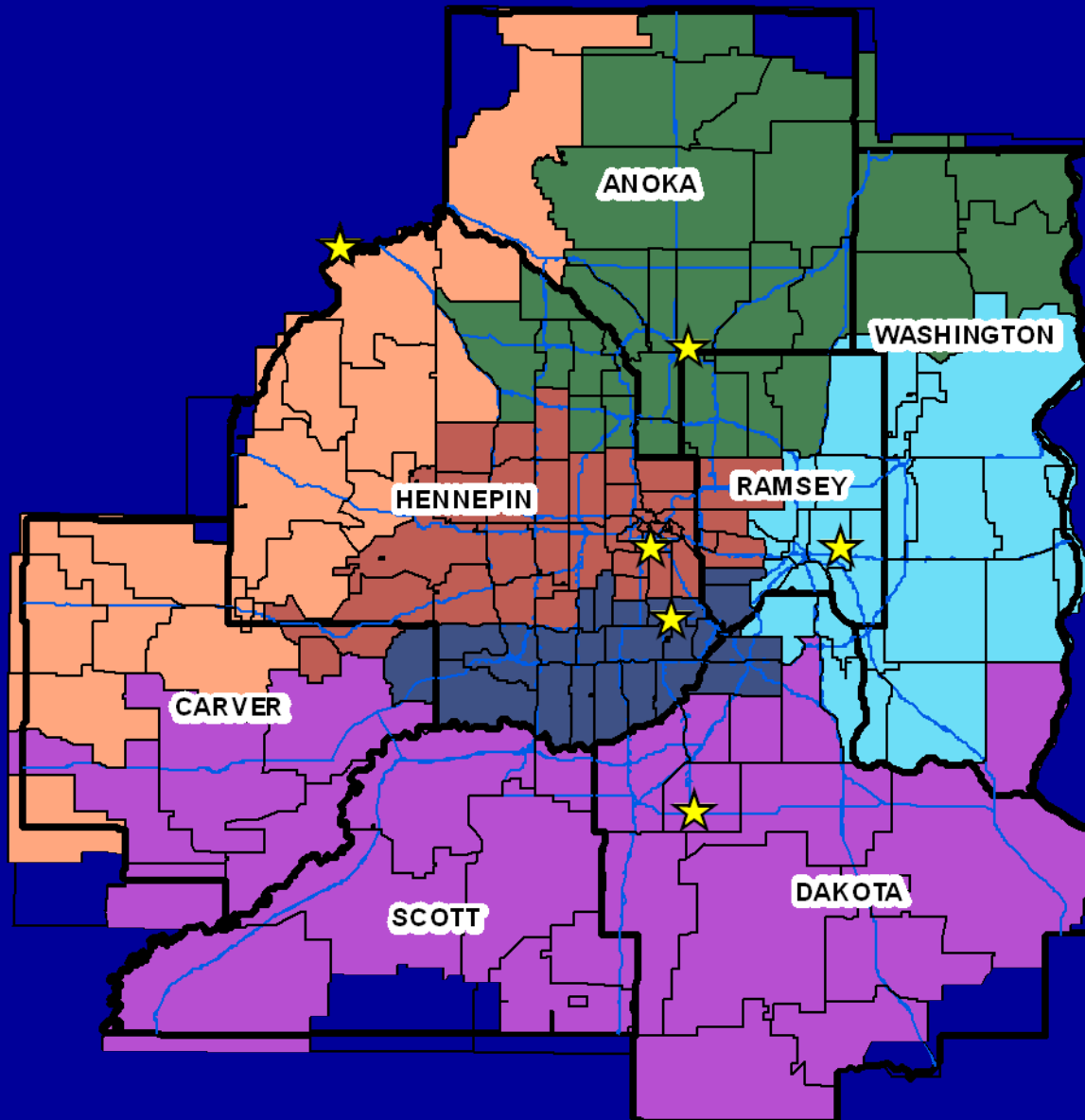
- ★ **Need to assign population exposure**

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

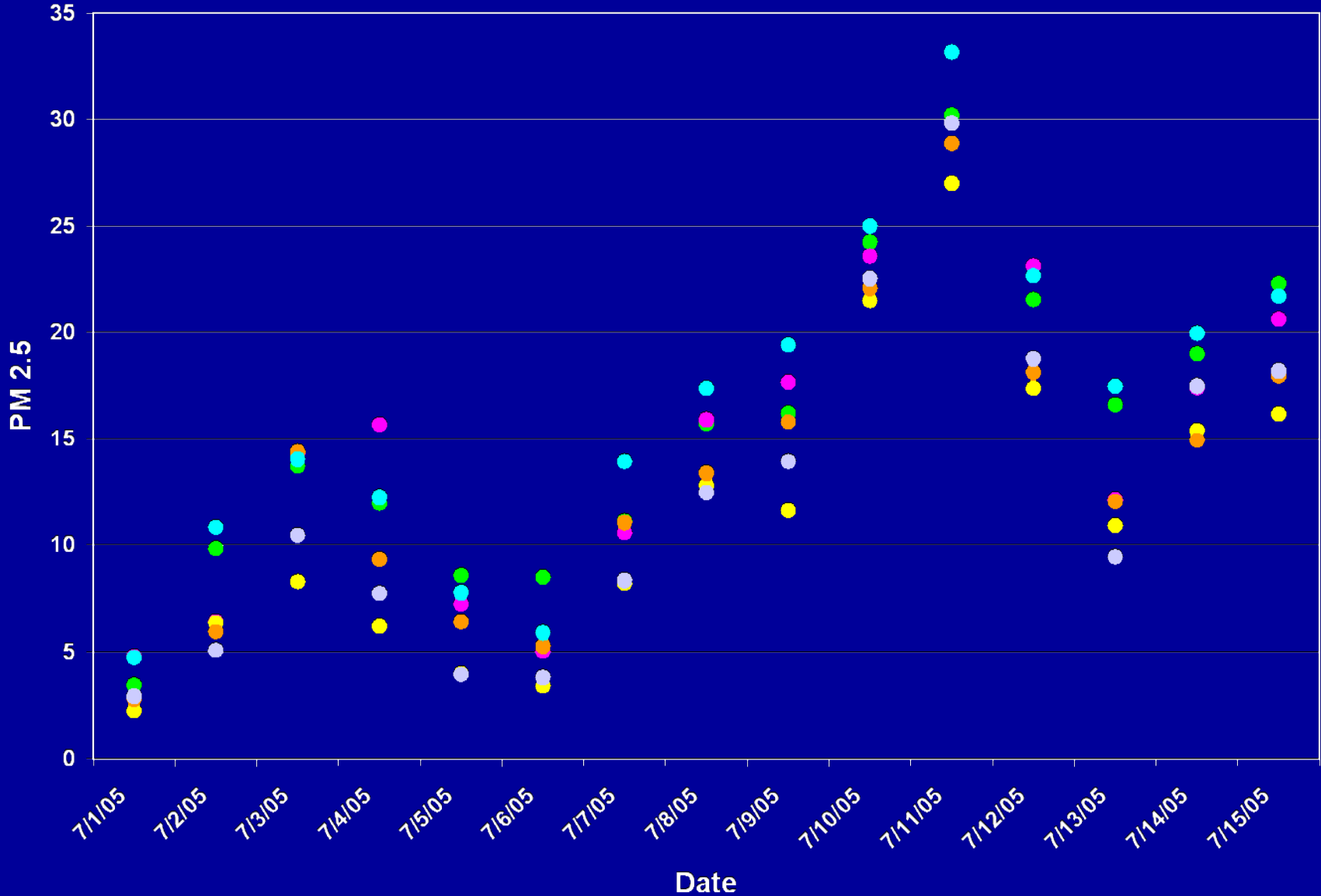
Monitor Locations- 7 County Metro



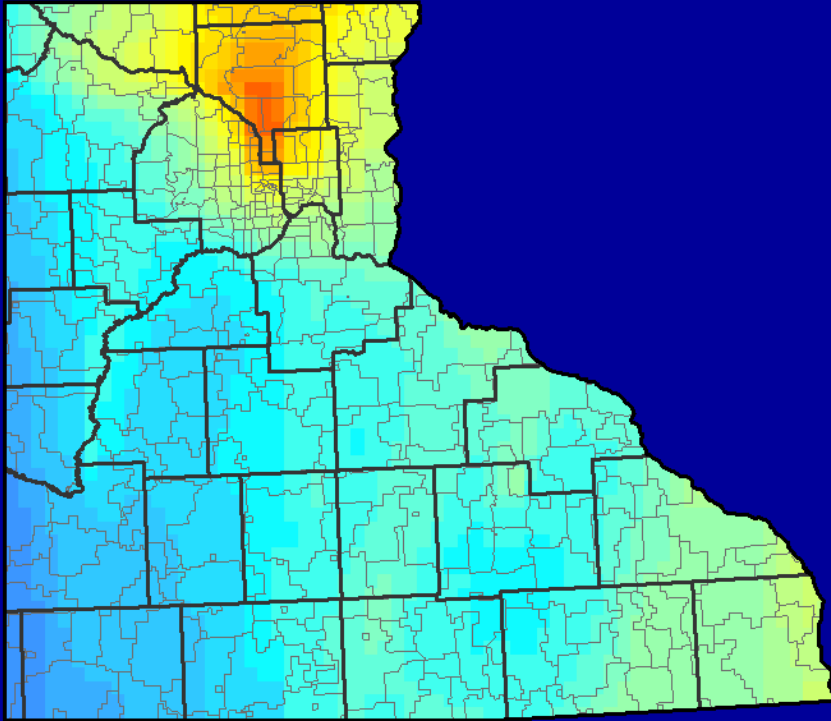
Closest Monitor to Zip Code Centroid



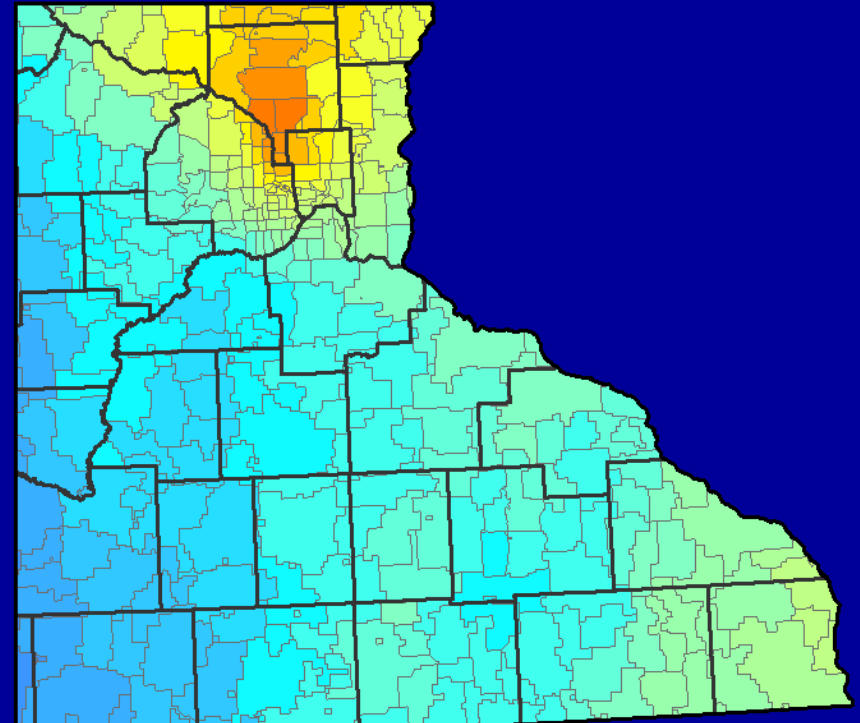
Monitor Spatial Variation



Emissions model data



4 km grid



Zip code level

PM2.5 Concentration
(ug/m3)



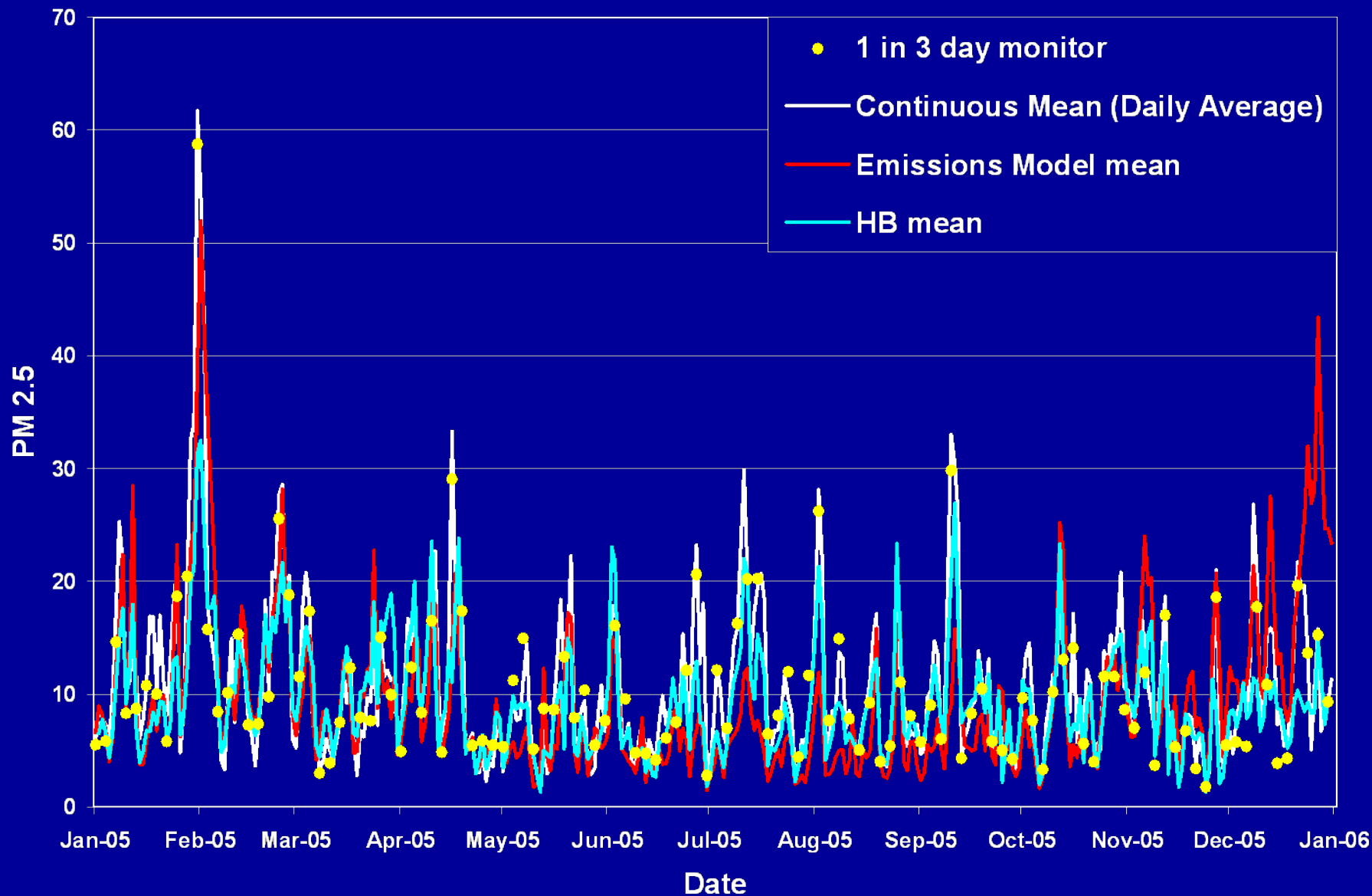
Hierarchical Bayesian modeled data

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

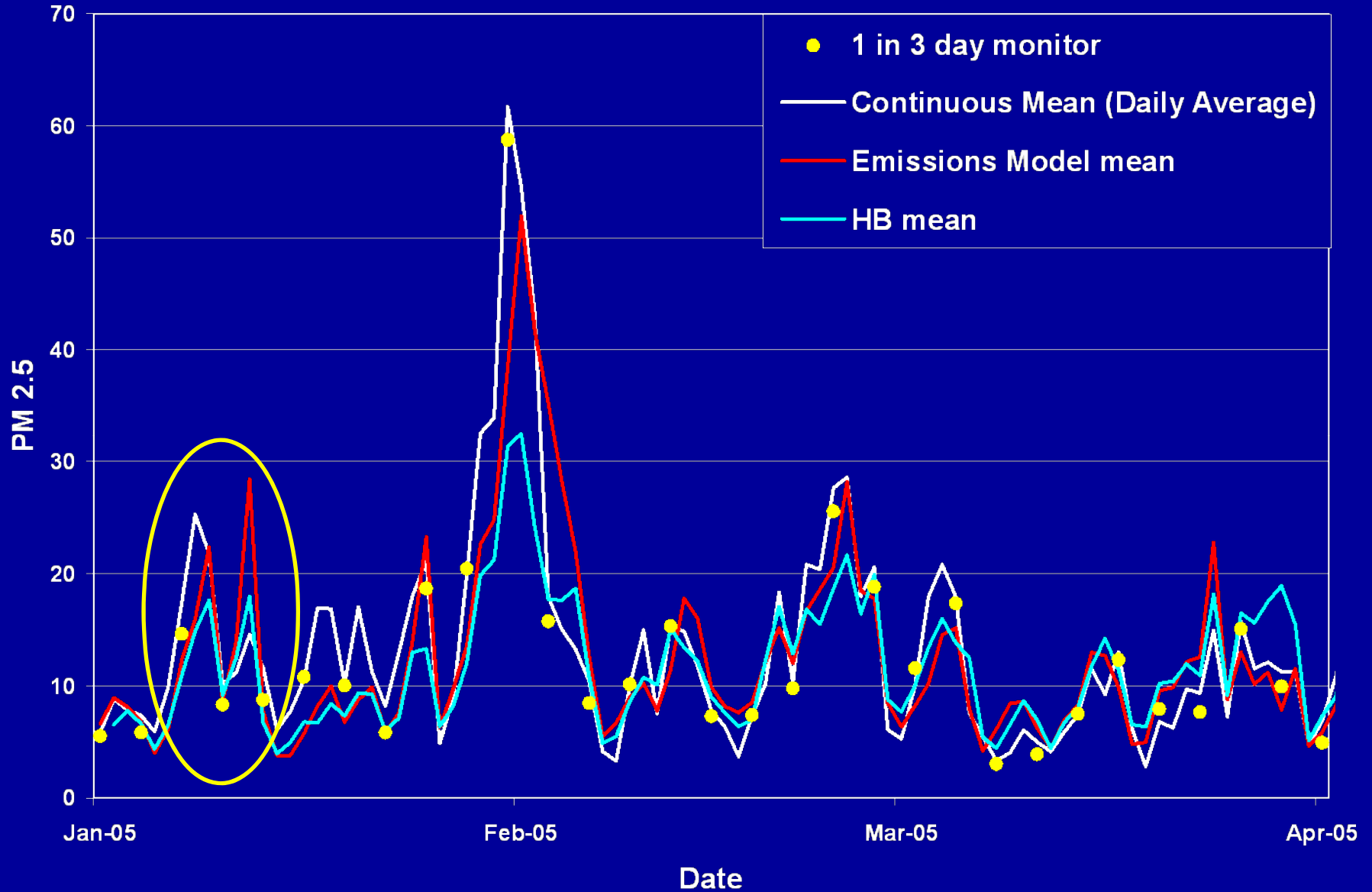
What measure do we use?

- ★ **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**

Air Data Source Comparison-2005



January-March 2005



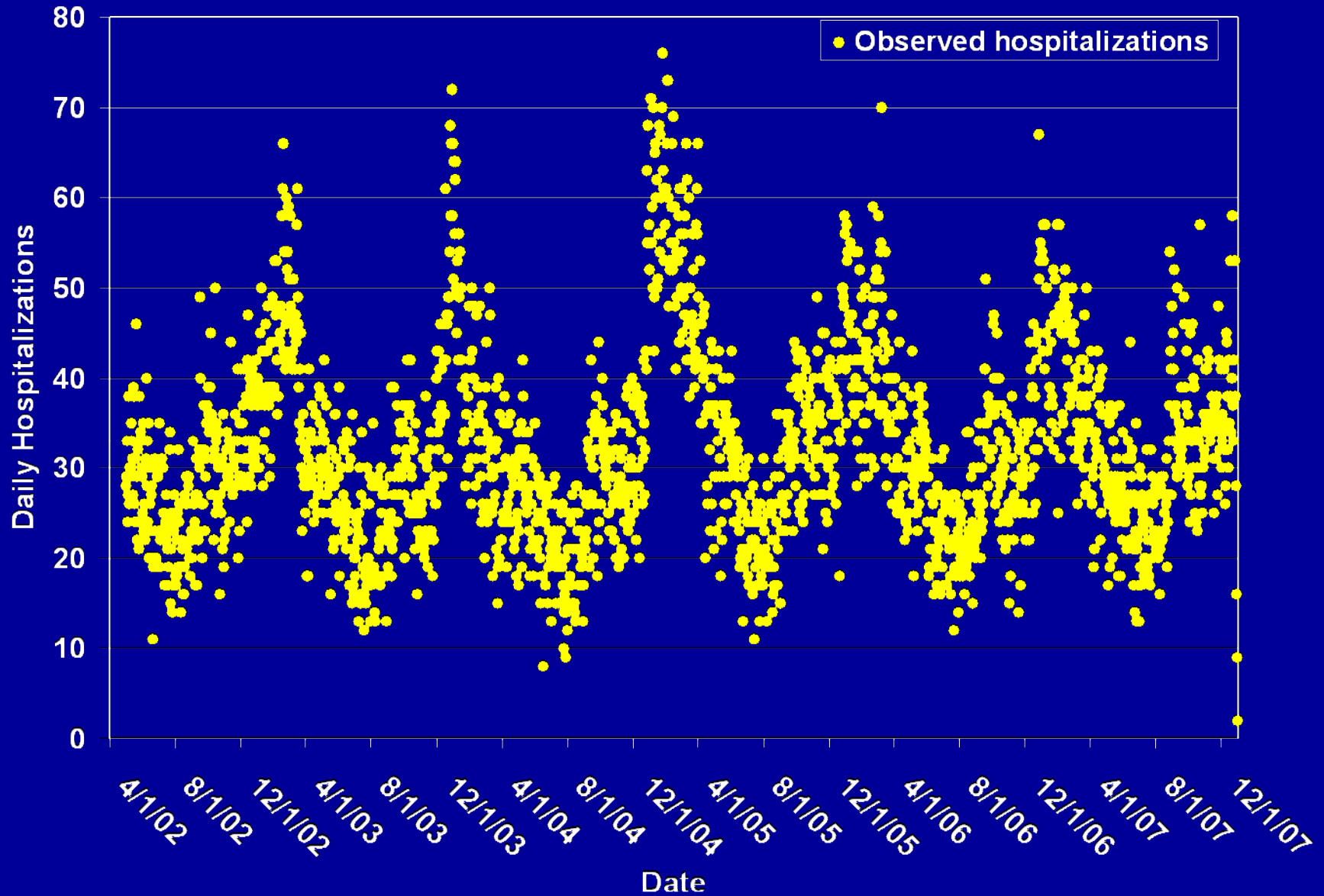
Statistical Methods for Analysis

- ★ Time Series-Poisson model
- ★ Case-Crossover analysis

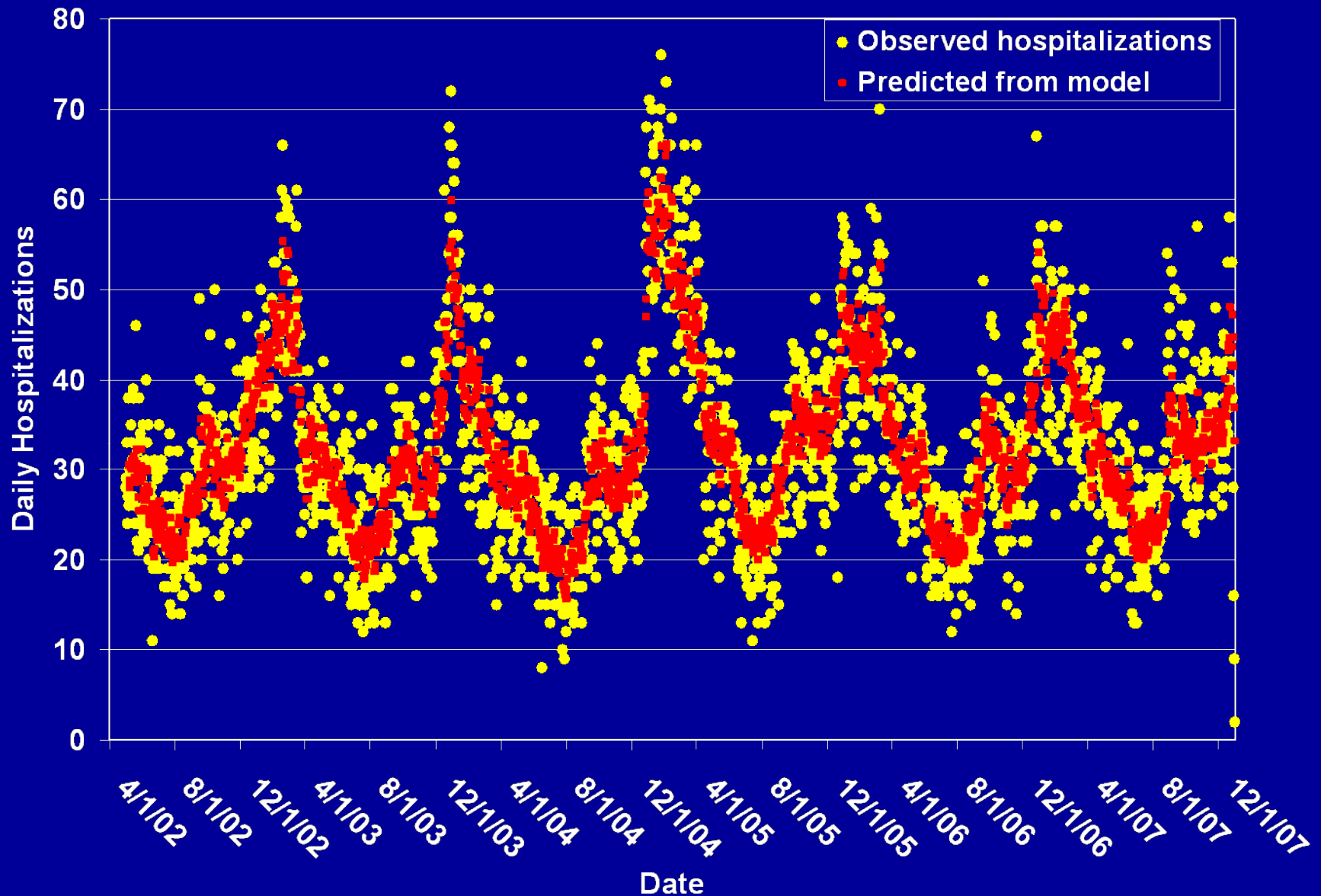
Time Series Analysis

- ★ **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**

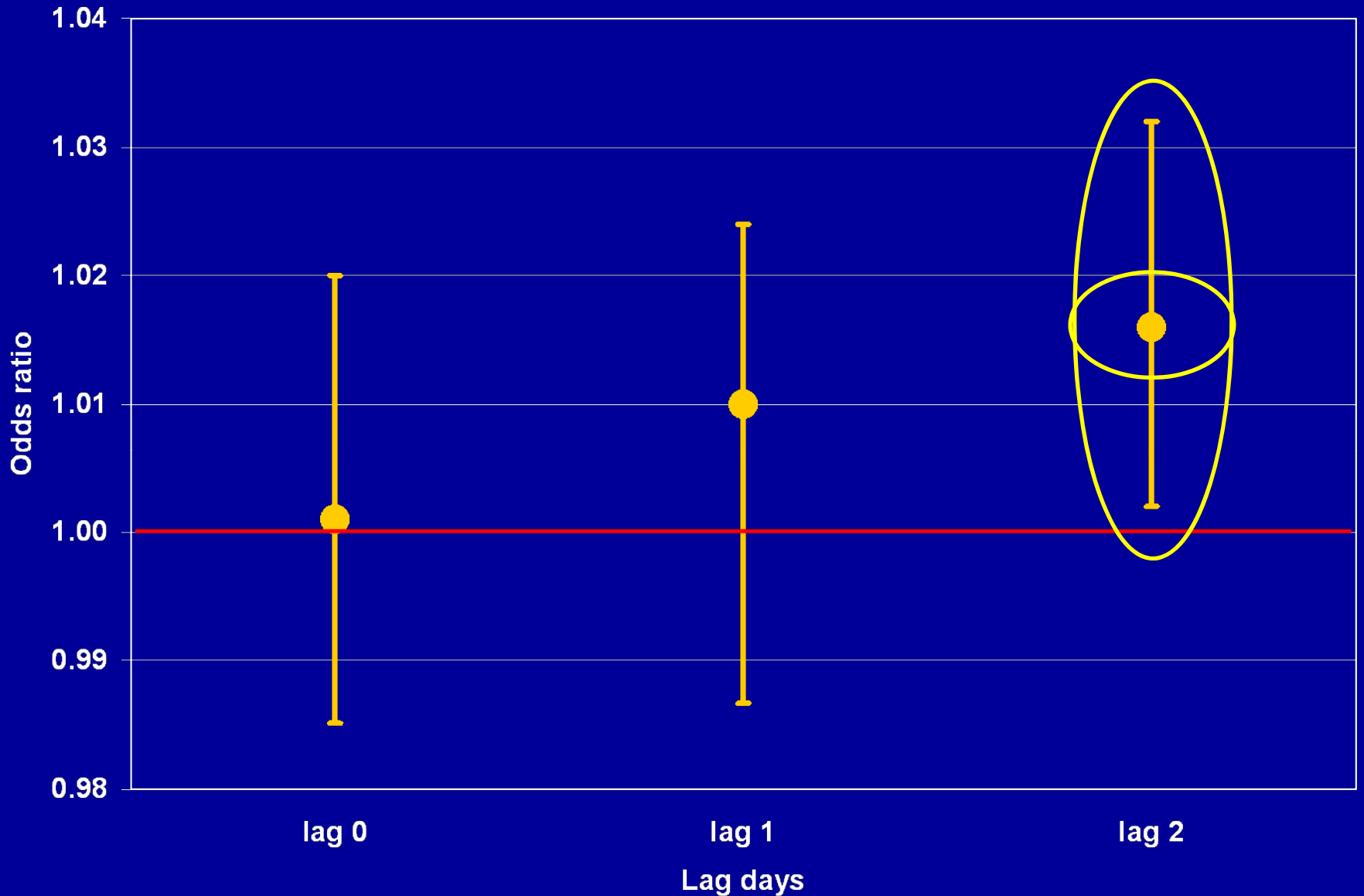
Total Respiratory Time Series results



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**

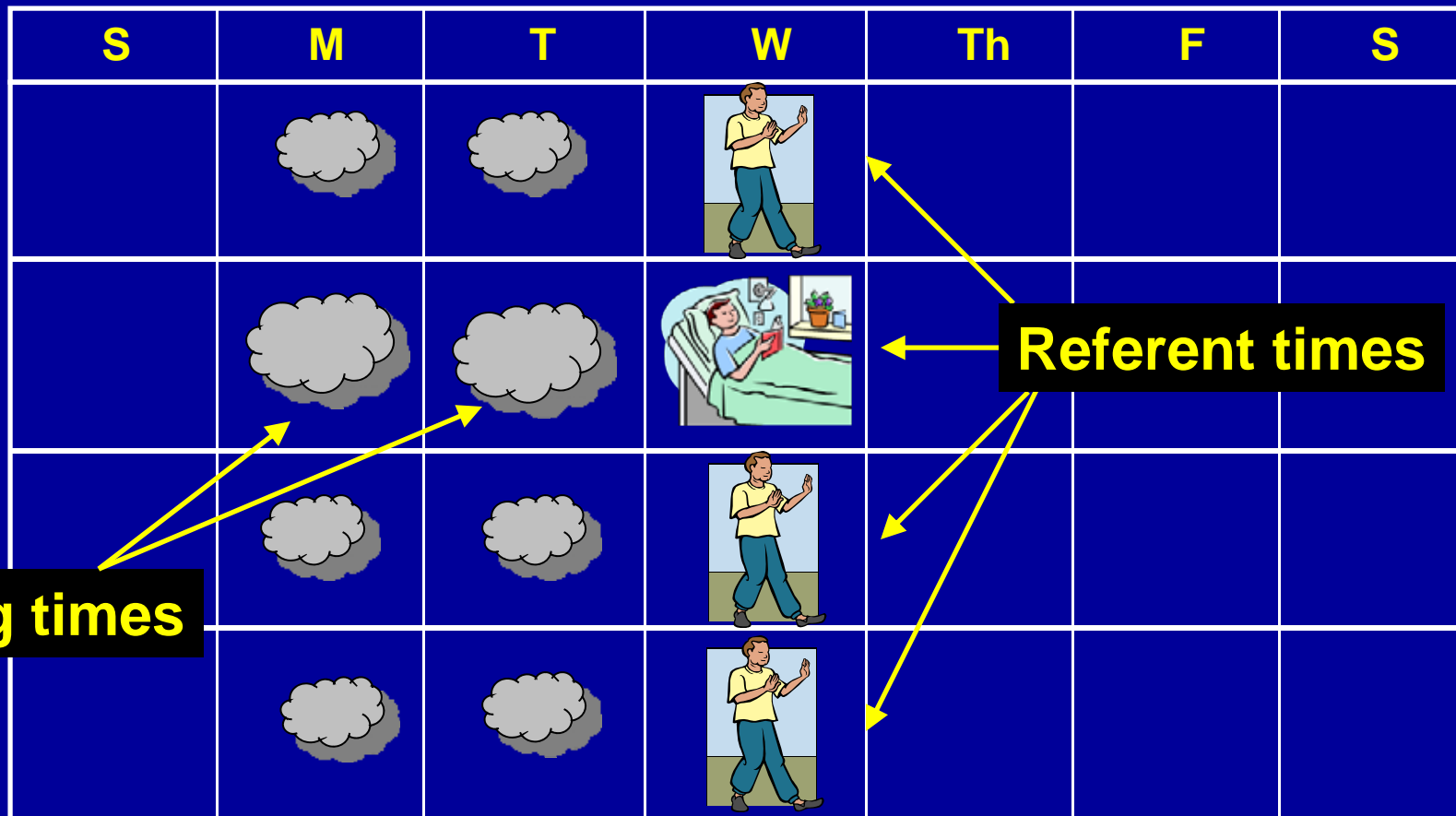
Case-Crossover Analysis

- ★ **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**

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

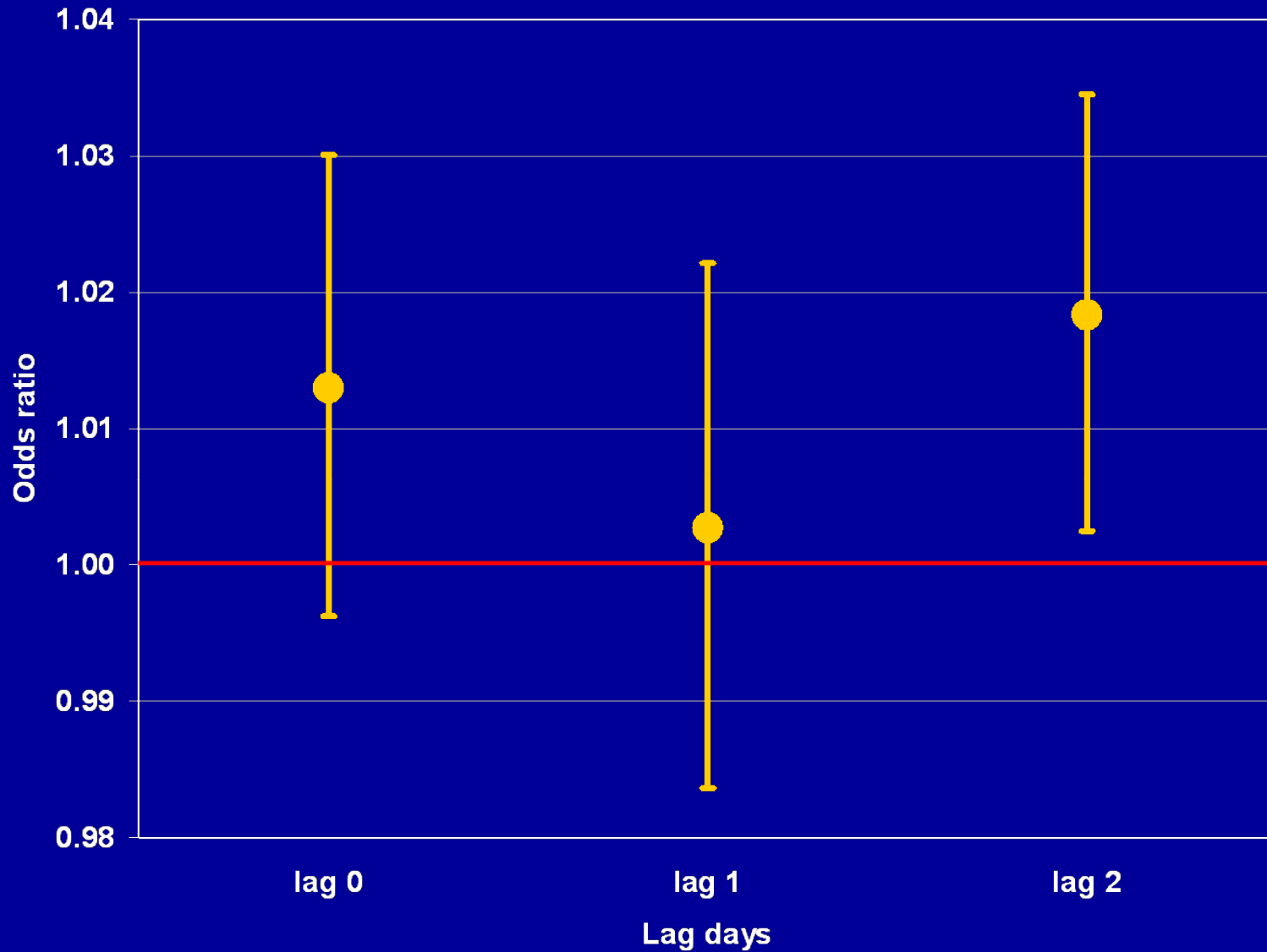
– Cumulative lags

- Sum of lag0, lag1 and lag2

★ Driven by clinical evidence

★ Chosen by modeling strategy

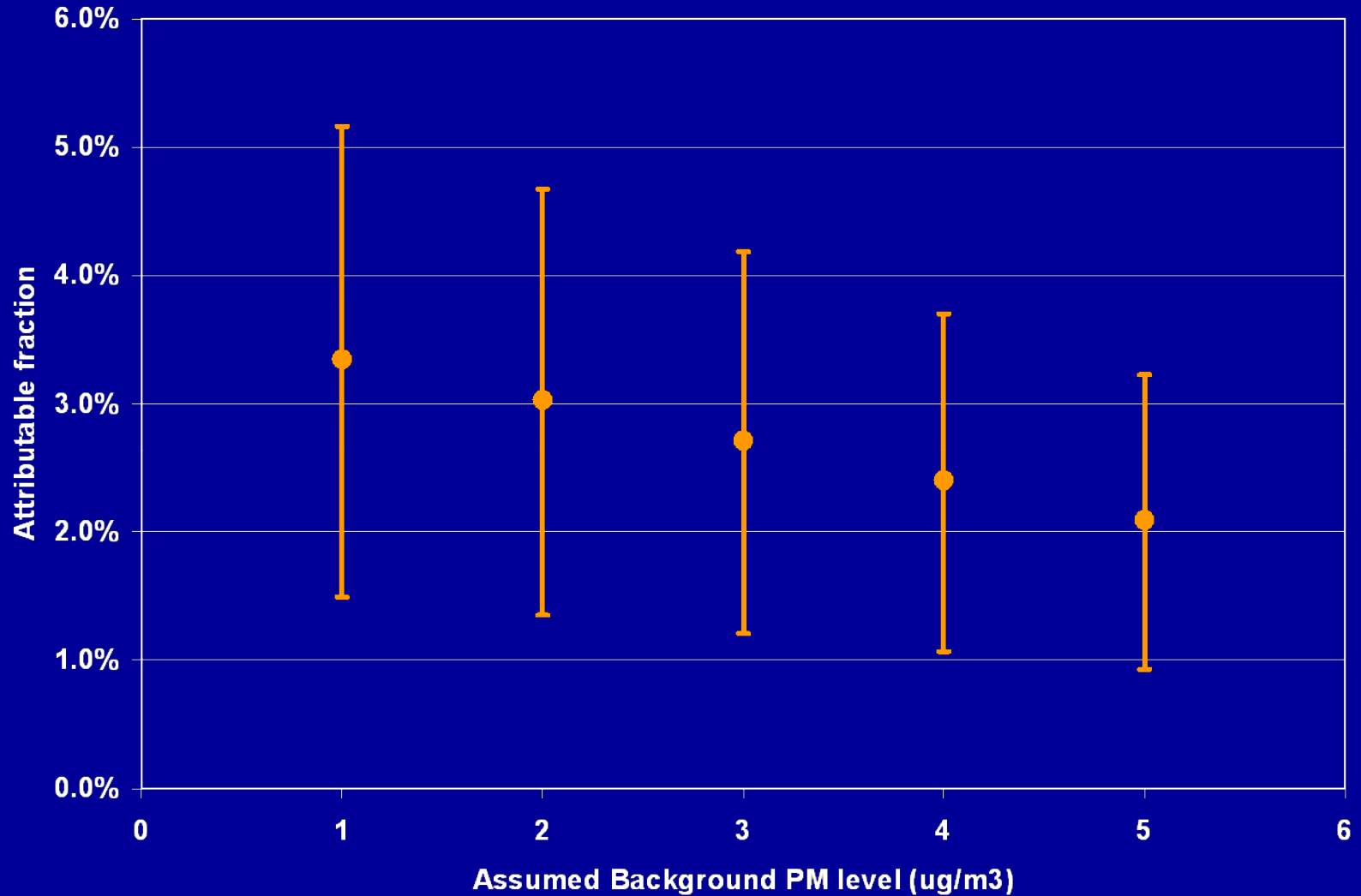
Case-Crossover results



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

Attributable Fraction results



Directions for future analyses

- ★ **Spatially assigned air data**
- ★ **Other pollutants (PM₁₀, ozone)**
- ★ **Traffic data**
- ★ **Ambulance data**
- ★ **Pediatric vs. Adult**
- ★ **Seasonal data (ozone)**
- ★ **Pollen**
- ★ **Noise**

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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