Spatial Investigation of Sources, Composition, and Long-Term Health Effects of Coarse PM

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Talk Overview

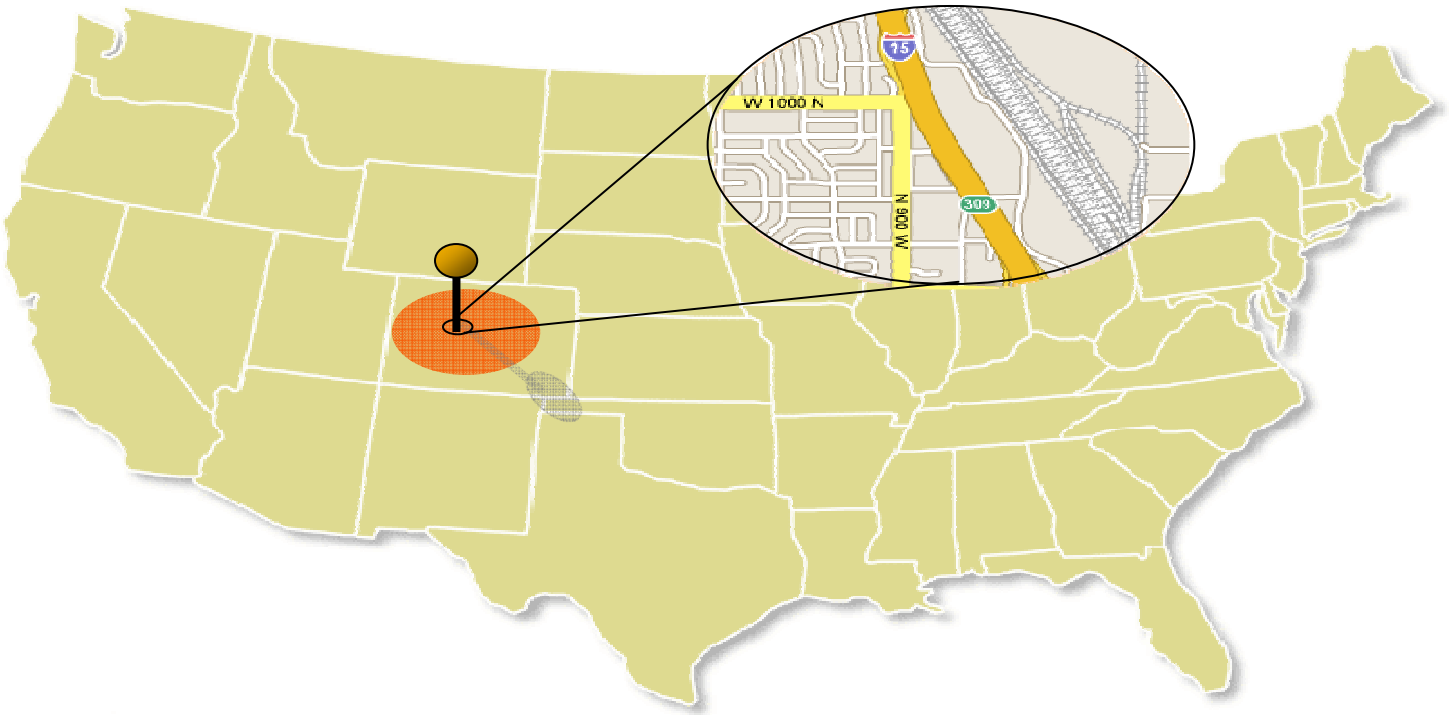
- Background
- Study Aims
- Data Collection Plans
- Preliminary Data
- Planned Epidemiology Analyses
- Expected Contribution

Health Effects Not Well Characterized

- Past studies generally focused on PM10 or PM2.5
- There is some evidence of cardiovascular and pulmonary health effects from coarse particles
- Data regarding chronic health effects are very limited

Exposure Assignment for Chronic Health Effects Can Be Difficult

- Spatial variation of PM10-2.5 can be large due to local sources



Little Information Available on Source-Specific Health Effects

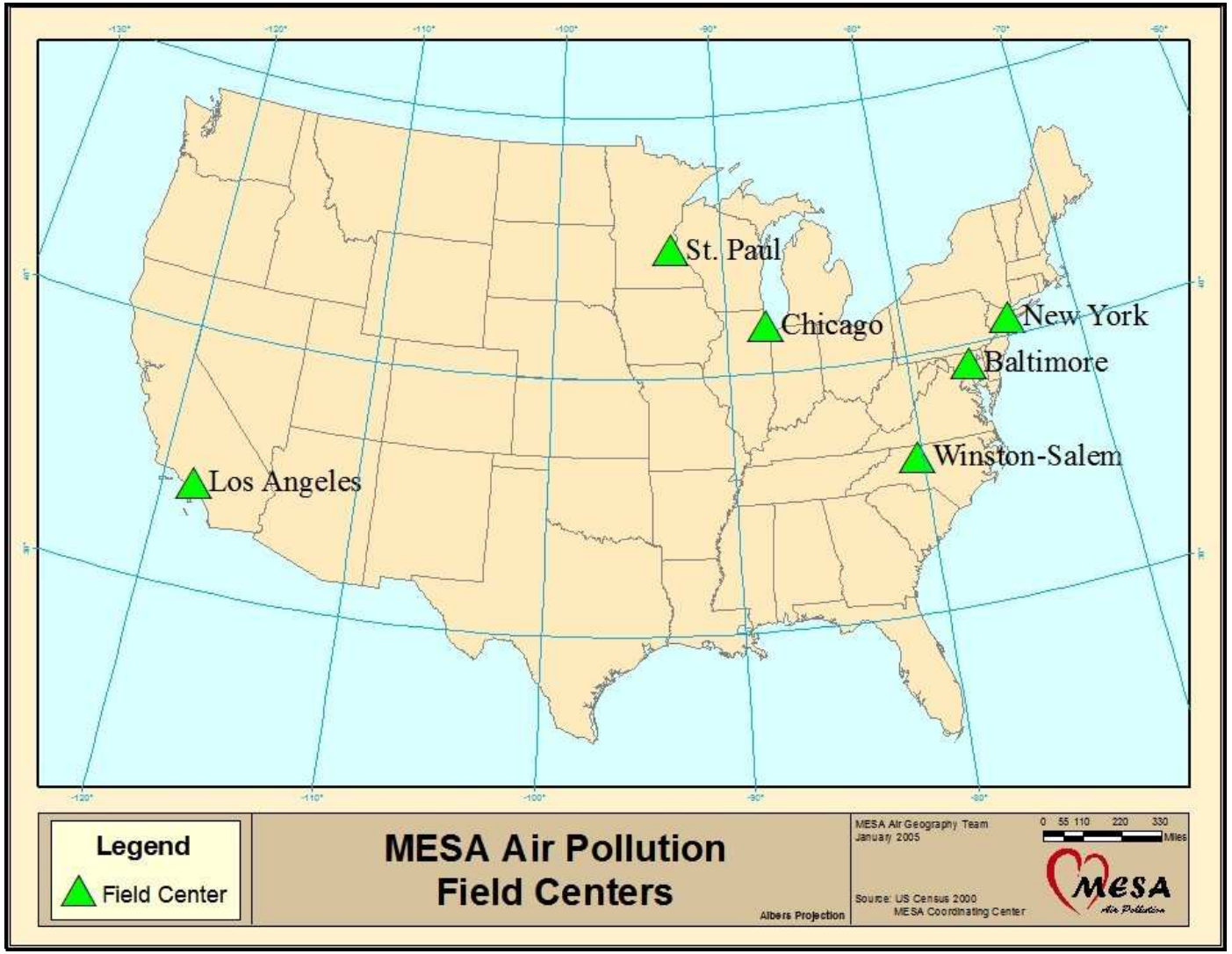
- Speciation data rarely rich enough to characterize spatial variability of sources
  - Natural sources of windblown dust and biological agents
  - Suspended dust from traffic and other anthropogenic activities

Study Aims

1) Characterize spatial variability of PM10-2.5 from natural and anthropogenic sources

2) Examine chronic health effects of PM10-2.5 on the respiratory and cardiovascular systems

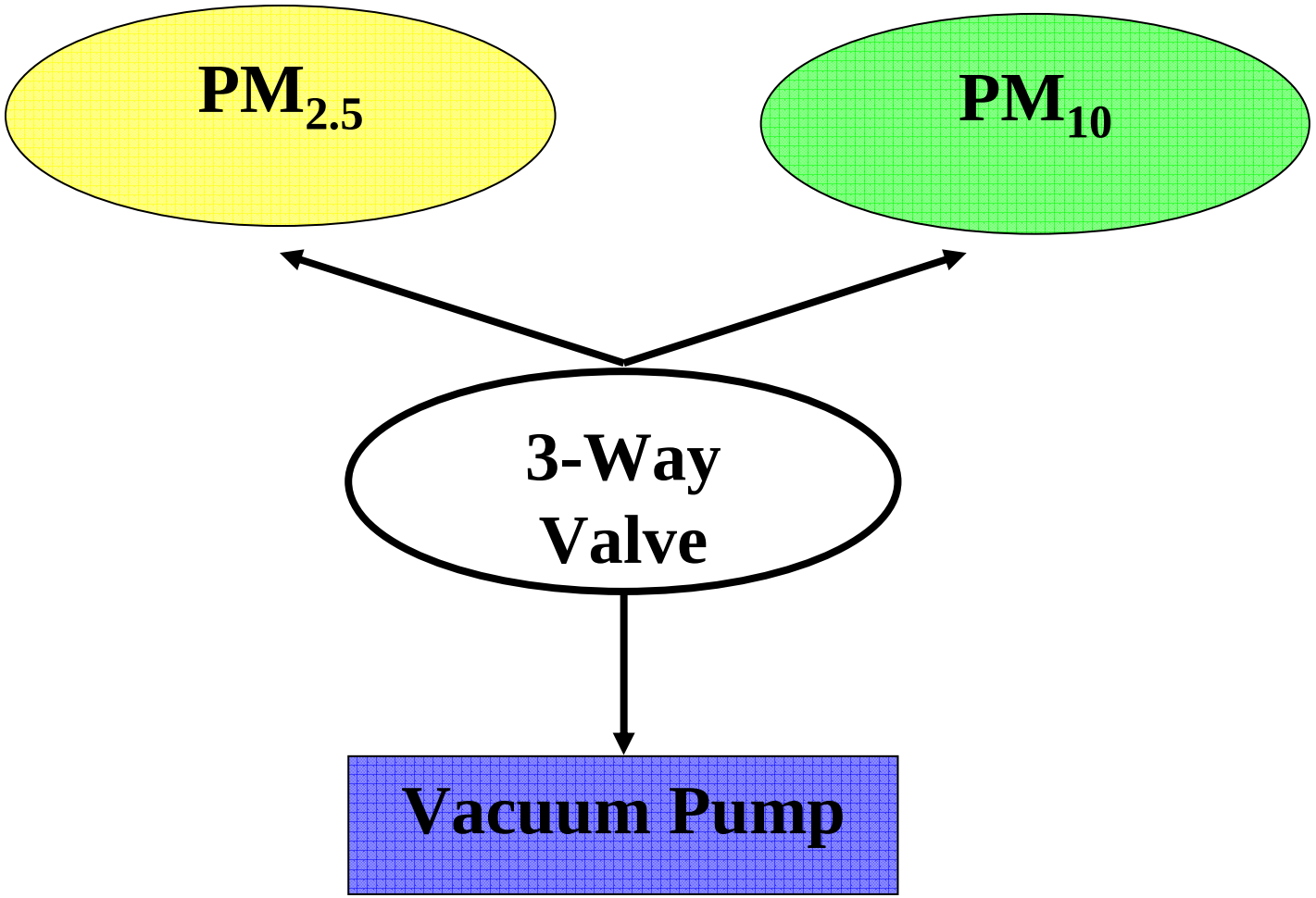
Nested in the Multi-Ethnic Study of Atherosclerosis and Air Pollution



Leverages the MESA Air Cohort

- Large infrastructure in place
  - High consent (>80%) for air monitoring
  - Geographic covariates compiled
  - Trained technicians
  - Access to sampling equipment and laboratories

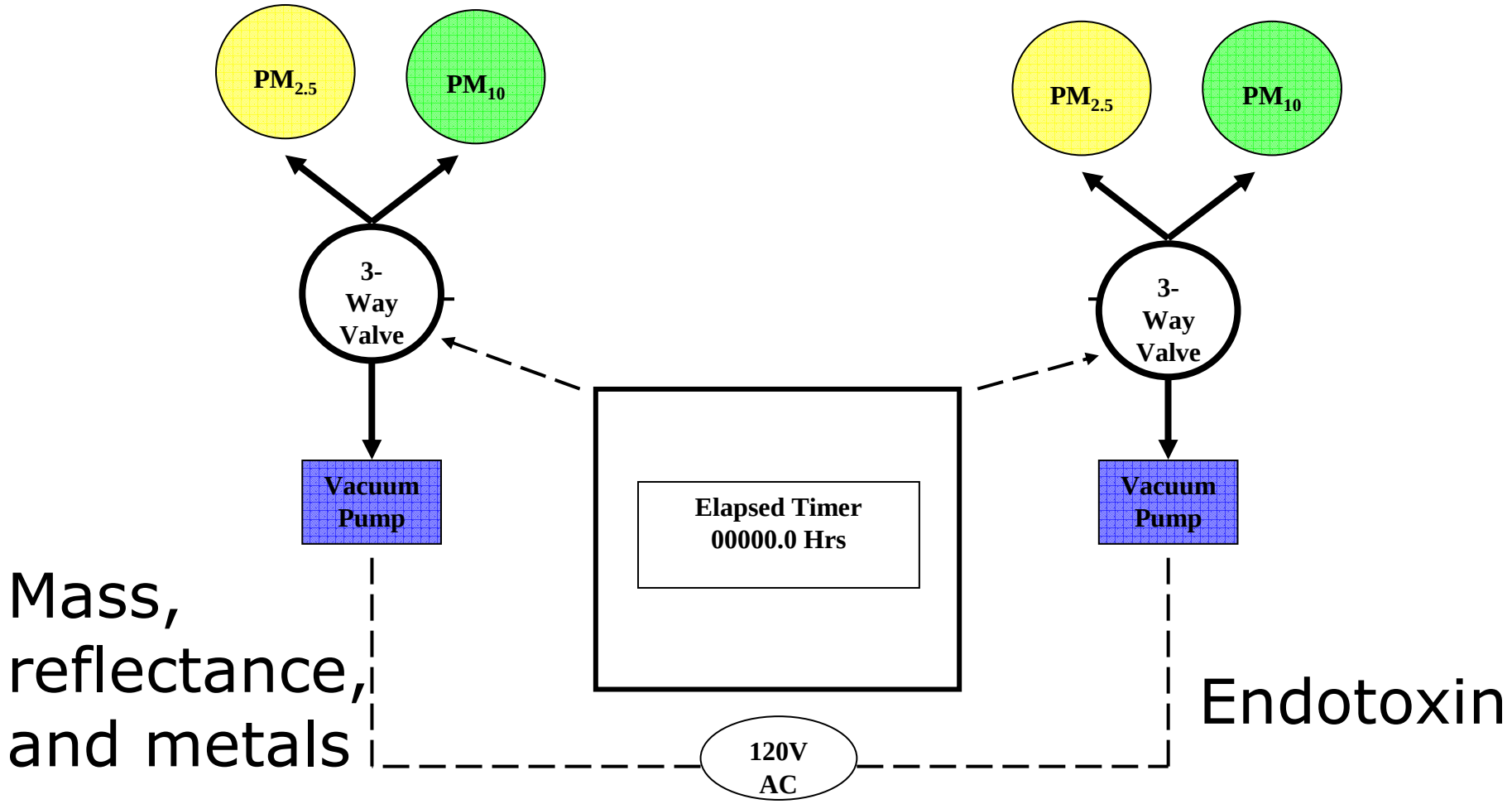
Sampler Configuration to Optimize Existing Equipment



Concurrent $PM_{10-2.5}$ Samples Planned

- Simultaneous data collection outside the homes of 40 participants
  - Targeted to reflect range in concentrations and characteristics
- 2-week integrated samples with each filter on half duty cycle
- Repeated during summer and winter

Analysis for Mass and Components



Mass, reflectance, and metals

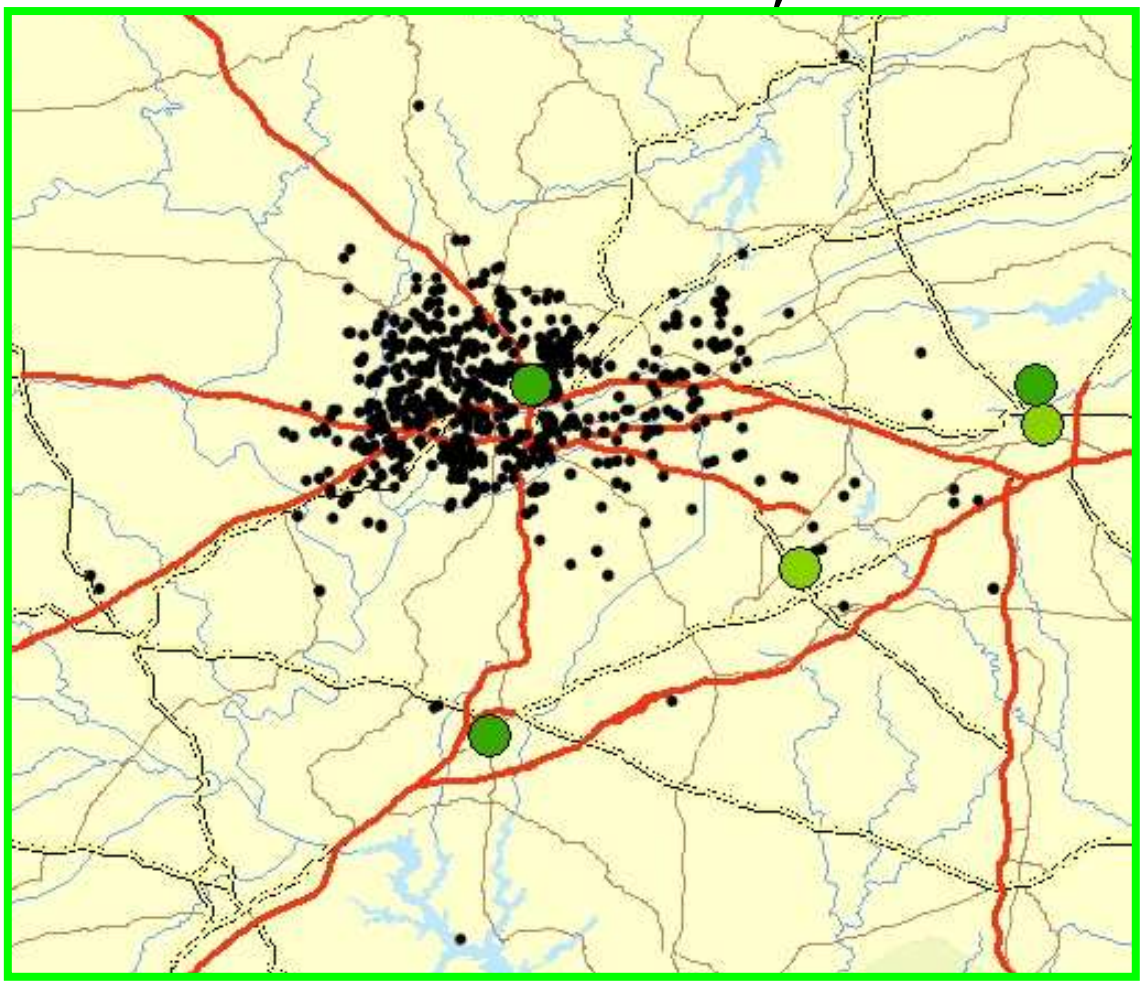
Endotoxin

Three Cities Selected for Monitoring

- Three of the MESA Air locations were selected to provide a range of concentrations and geographic predictors
  - Agricultural use, local extent of vegetated area, commercial/industrial use

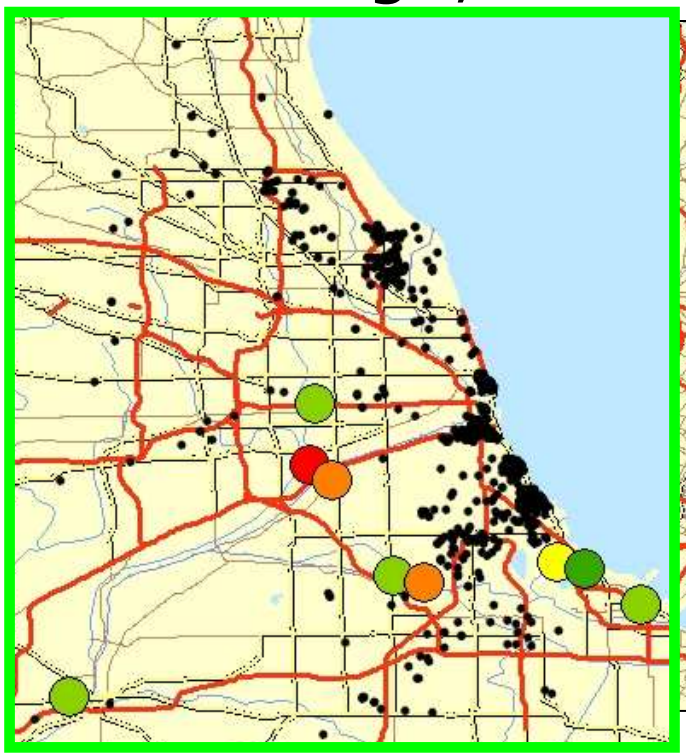
1 MESA Air City with Low Levels

Winston-Salem, NC

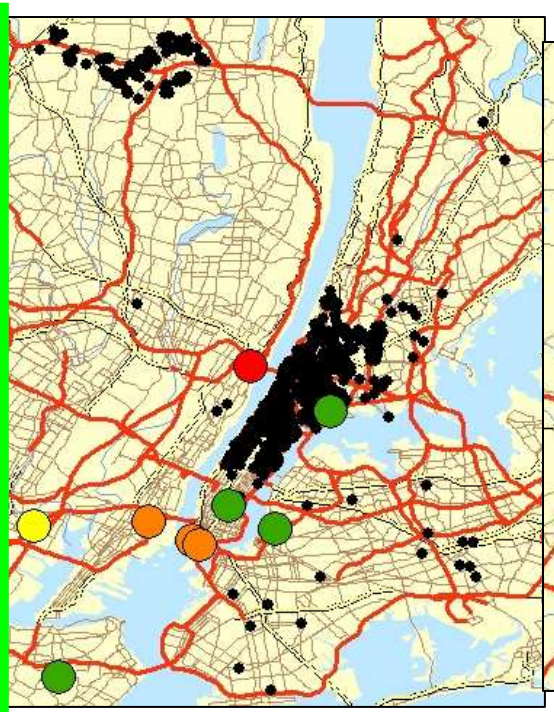


3 Cities with Moderate Levels

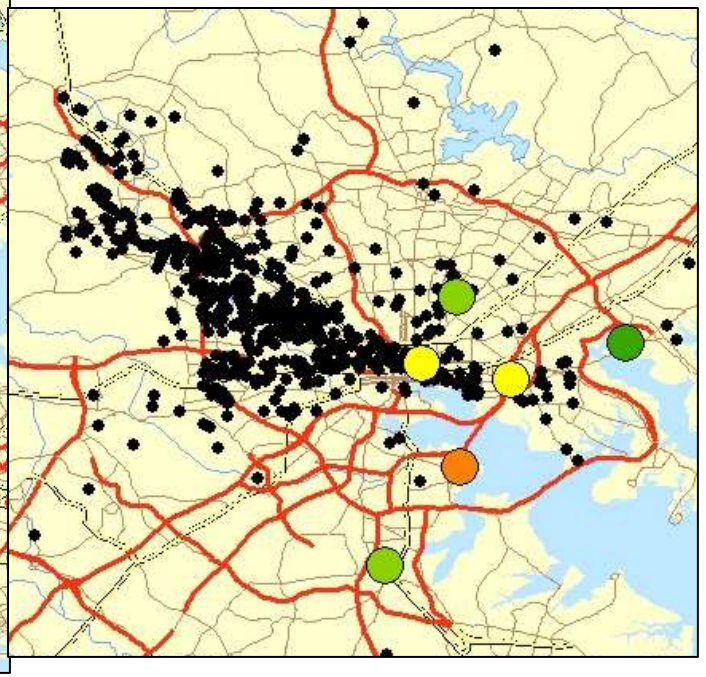
Chicago, IL



New York, NY

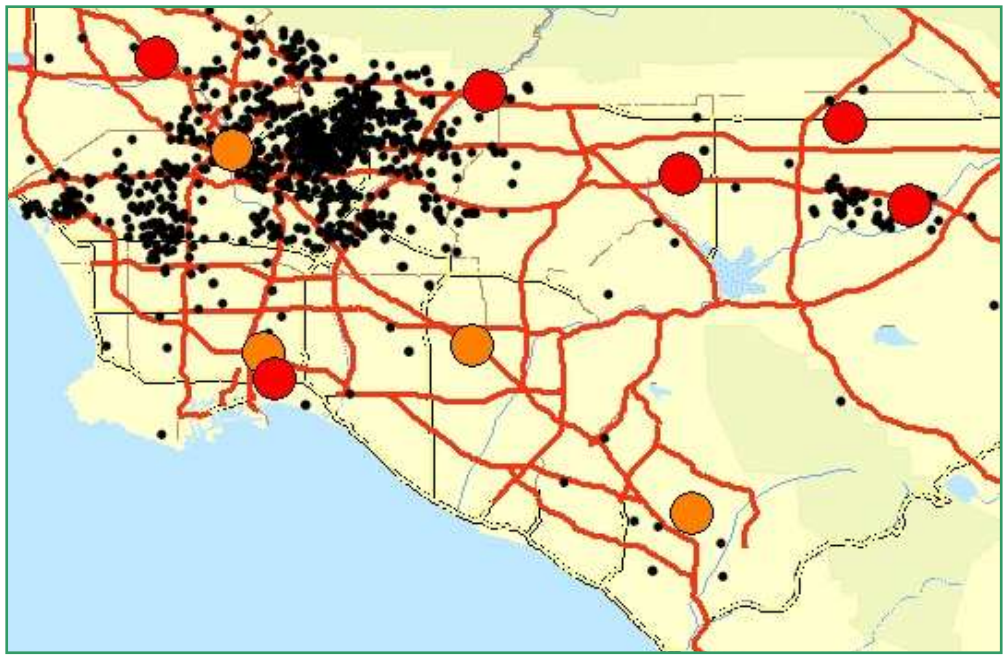


Baltimore, MD

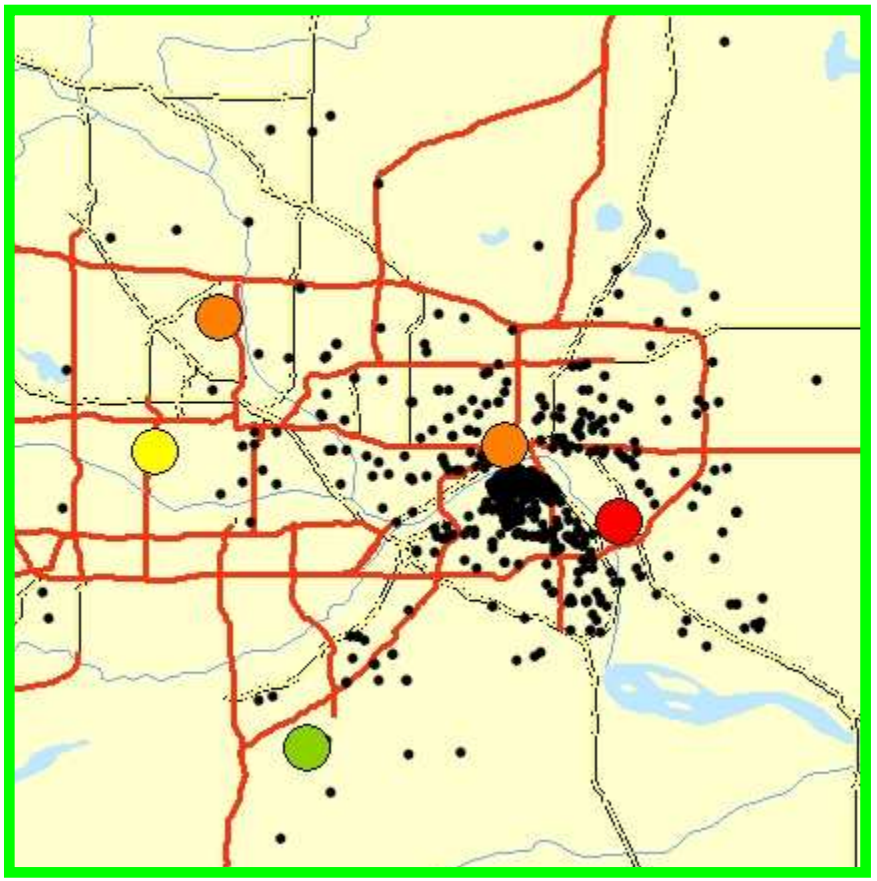


2 Cities with High Levels

Los Angeles, CA



St Paul, MN



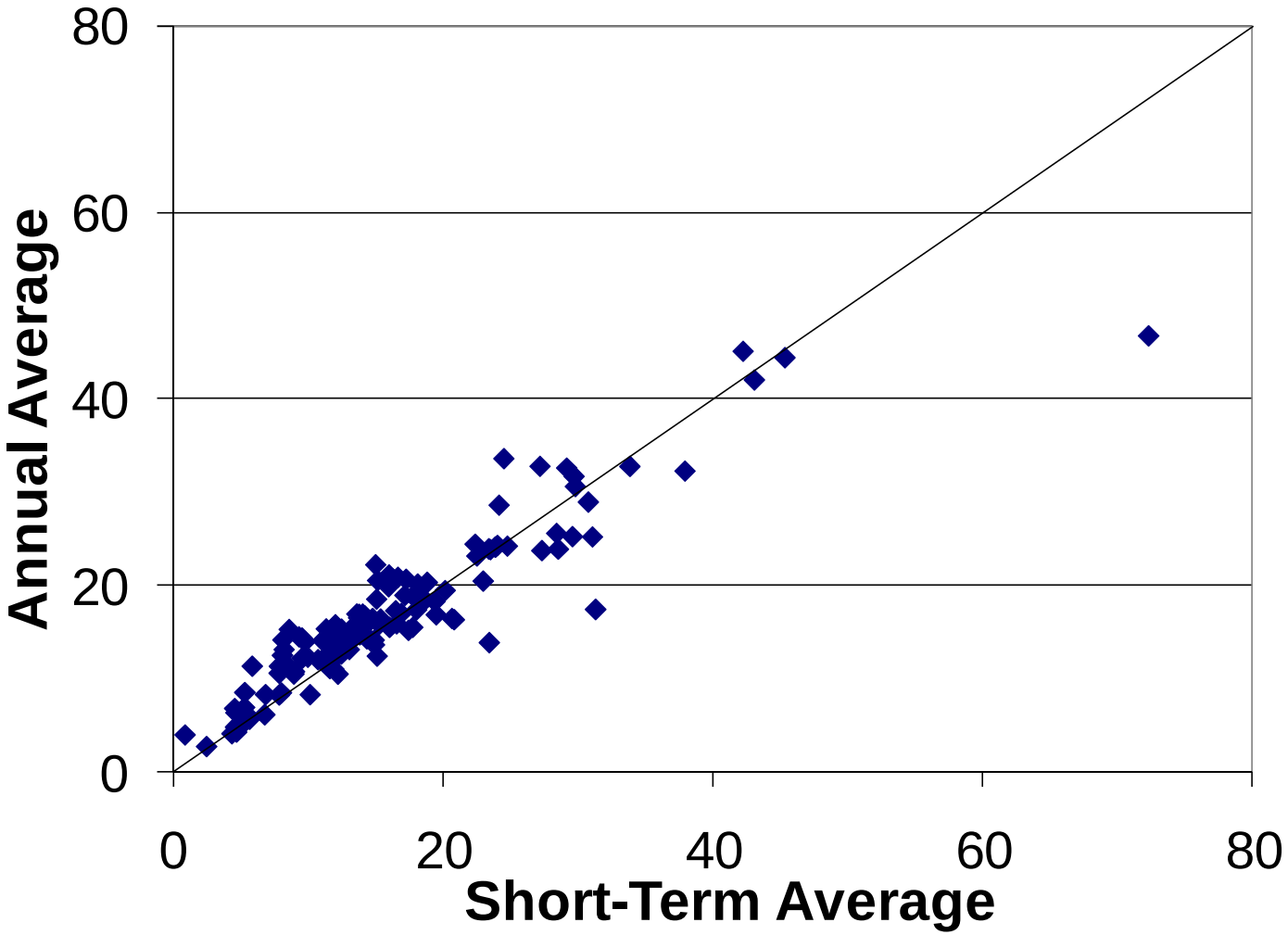
PM10-2.5 Predicted Outside of Participant Homes

- Outdoor concentrations will be predicted for each participant using spatial regression models
  - Land use regression and kriging
- Predictions for total mass and indicator species of sources

Assumptions for Assigning PM10-2.5

- 2-week samples from summer and winter can represent a long-term average concentration
- PM10-2.5 levels can be predicted by spatial features

Short-Term Samples Reasonably Reflect Annual Averages



One Year of Data Reasonably Representative of Long-Term Average

- Rank order in AIRS data remained relatively stable
- Data from a single year can be used to reflect long-term averages

PM10-2.5 Can Be Predicted by Spatial Features

- Over 60% of the variability explained in 6 regions

	Change per IQR	p-value
NDVI	-4.8 (-7.8 to -1.9)	0.007
Distance to Roadways	-4.0 (-6.7 to -1.3)	0.007
Industrial/Commercial	3.5 (-0.4 to 7.4)	0.10

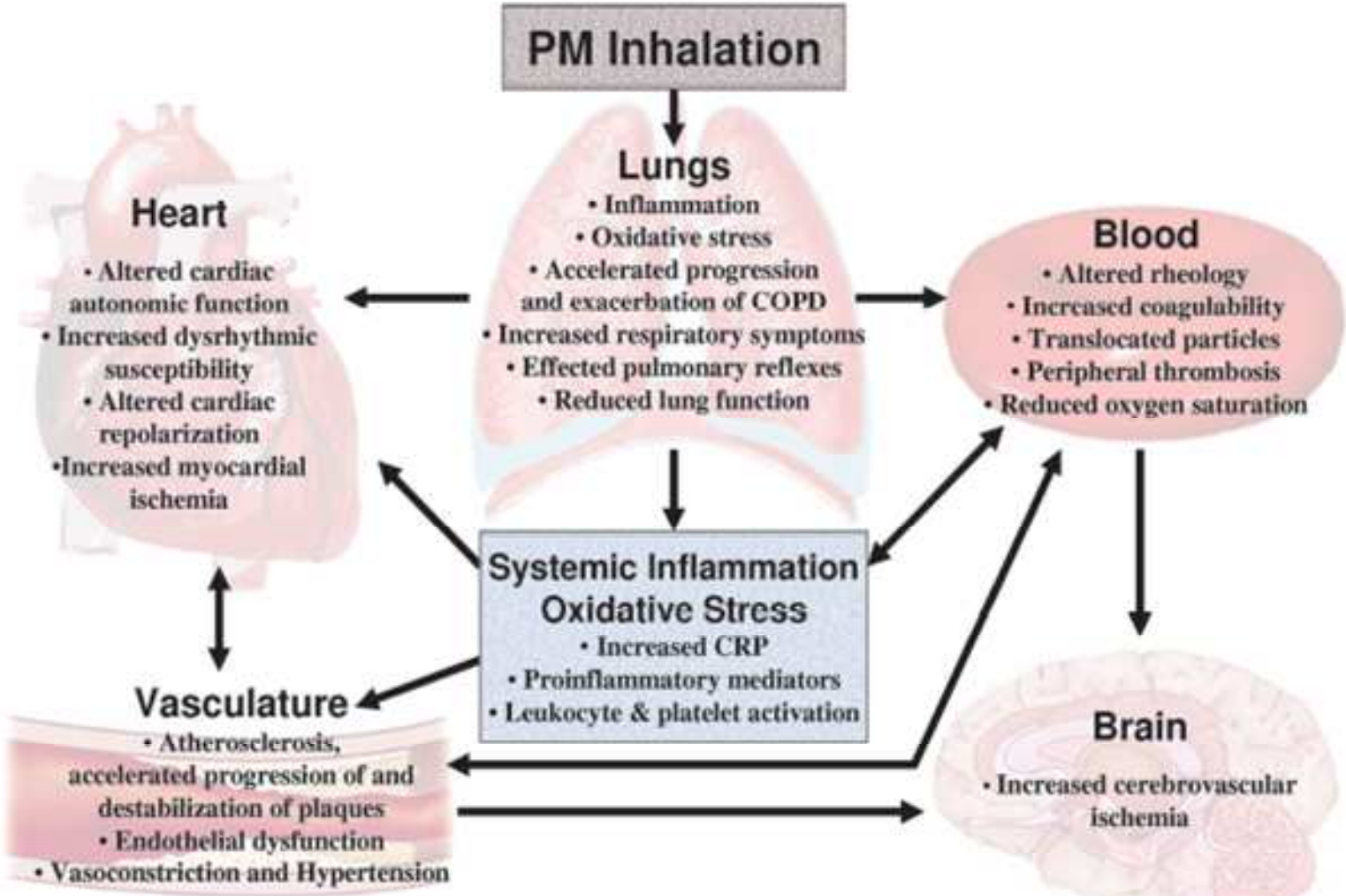
Final Assumption: Selected Cities Are Informative of Other Areas

- Powered to look at 3 cities, however, we would like to be able to explore associations in all areas
- Plan to evaluate consistency across regions and ability of models to predict at regulatory monitors
- Exploring passive samplers to extend to new cities
- Can assign exposure based on AQS monitors or covariates

Exposure Assessment to Inform Health Analysis in MESA Air Cohort

- Prospective cohort study
- >6,000 multi-ethnic participants
  - Chinese, Hispanic, African American, Caucasian
- 45-80 years old
- No clinical cardiovascular disease at baseline

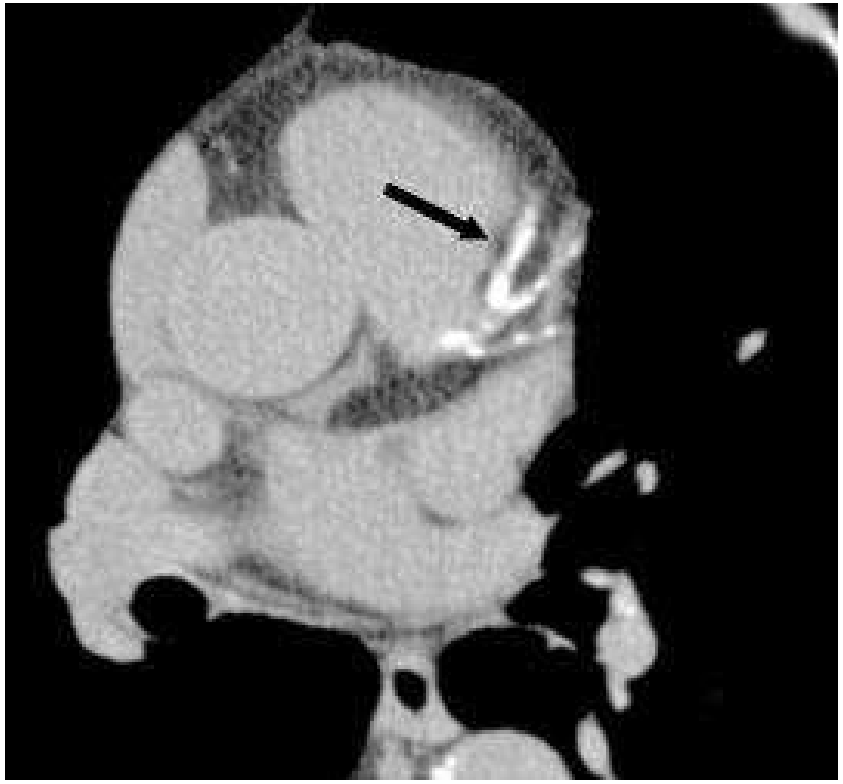
Proposed Modes of Action



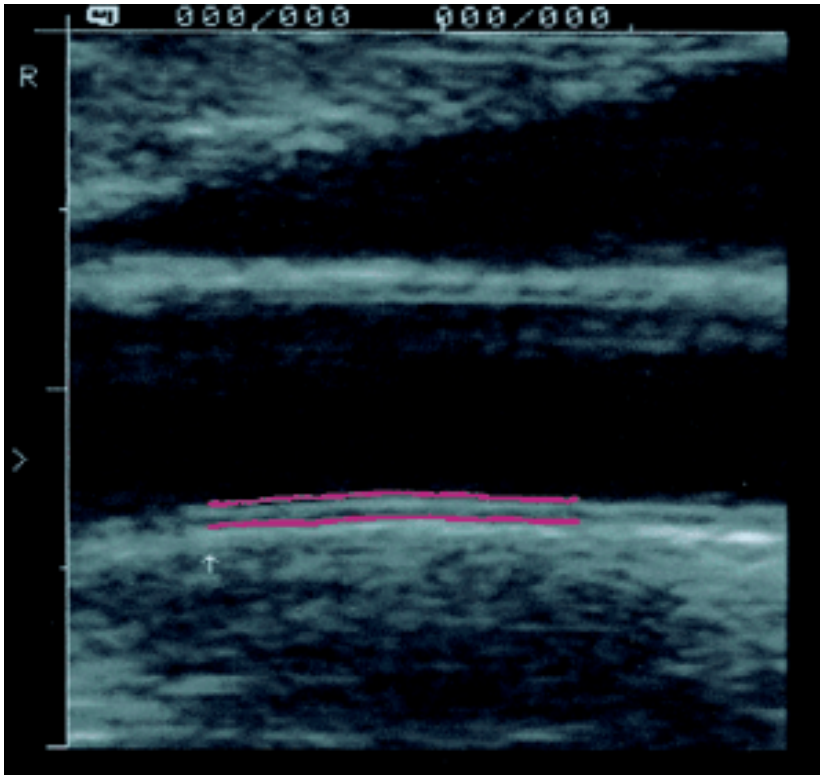
Pope and Dockery. JAWMA. 2006

Subclinical Cardiovascular Outcomes

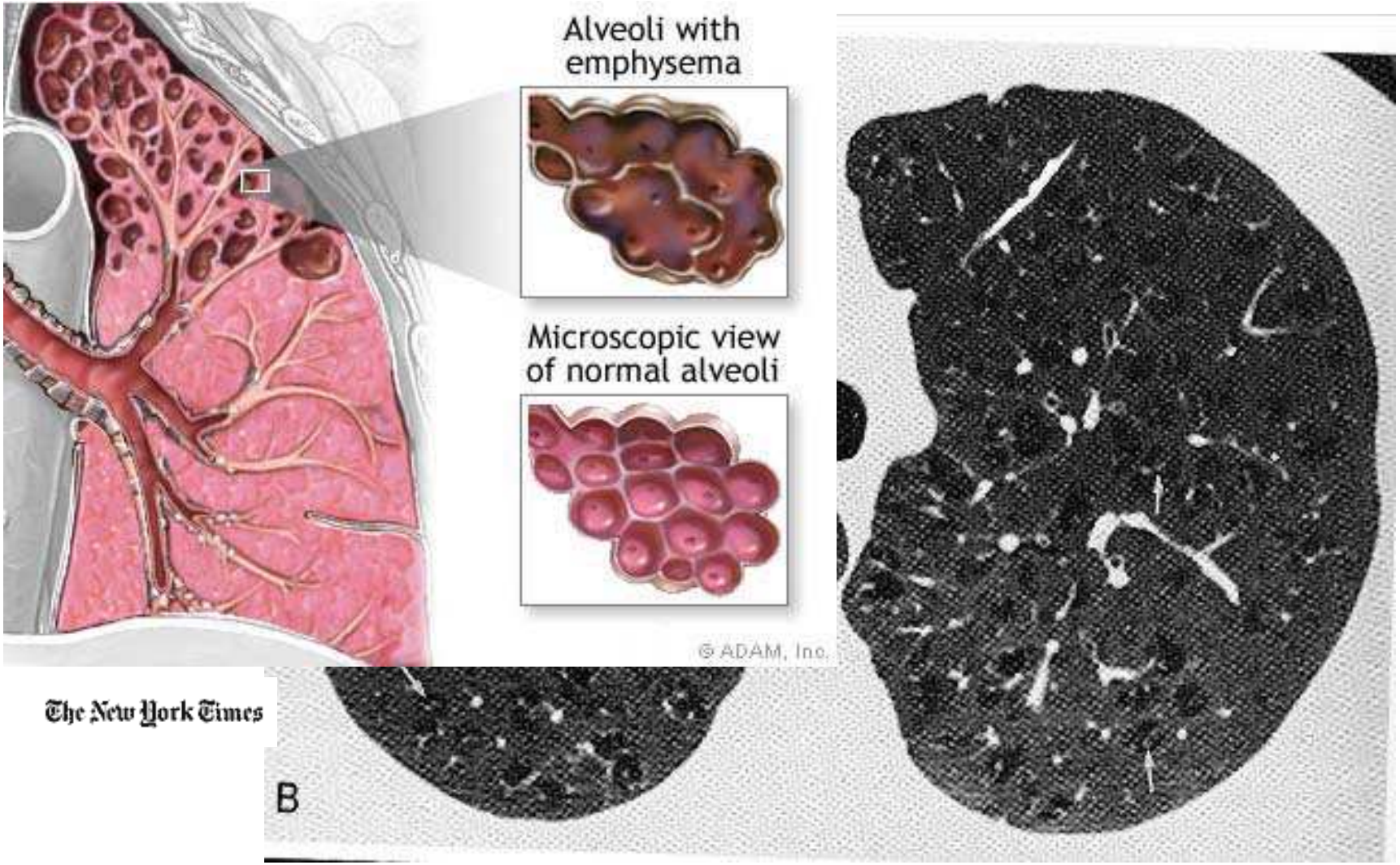
Progression of
Coronary Artery Calcium



Progression of
Intima-Medial Thickness



Subclinical Respiratory Outcomes



Clinical Events

- Cardiovascular events (including MI, stroke, angina, revascularization)
- Respiratory hospitalizations including COPD and asthma events

Planned Epidemiology Analyses

- Evaluate main effects of $PM_{10-2.5}$ and indicators of its sources on health
- Explore effect modification by race/ethnicity, age, SES, diabetes, and lipid lowering drugs
- Also investigate influence of multiple pollutants (including $PM_{2.5}$, light absorbing carbon, NO_x, SO_2) using MESA Air data

Anticipated Contributions

- Unique characterization of within-city variation of $PM_{10-2.5}$ and its sources
  - Spatial prediction models
- Explore chronic health effects
  - Clinical and subclinical
  - Ability to evaluate potentially sensitive subpopulations

Thank you for your attention.
Any questions?