AIR TOXIC MONITORING IN THE GREATER CINCINNATI / NORTHERN KENTUCKY AREA:

FOCUS ON TRAFFIC-RELATED AIR POLLUTANTS

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CINCINNATI CHILDHOOD ALLERGY AND AIR POLLUTION STUDY

WHY PM2.5 ?

- EPA standard
- Diesel signature characterized for PM2.5
- Easily dispersed and subjected to a long-distance transport in ambient air

CHARACTERISTICS

- PM2.5 mass concentration
- PM2.5 constituents associated with DEP
- Particle size distribution

WHY STUDY IS IN THE GREATER CINCINNATI AREA

- Concentric network of interstate highways surrounding 1.9 million
- 2-16,000 trucks/day/interstate
- Higher rates of smog related respiratory admissions than Boston or NYC
- Commonly referred to as the “allergy capital”

Sampling Equipment – PM2.5

- Harvard impactors (Air Diagnostics and Engineering Inc., Harrison, ME, USA)
- Particle collection on filters
- Sampling flowrate: 20 or 10 Lpm (2 impactor models)
- Samples are collected on Teflon filters for elemental analysis (XRF) and quartz filters for carbon analysis (TOT)

Sampling Equipment - PSD

- 8-stage MOUDI (100, MSP Corp., Minneapolis, MN, USA)
- Size-selective impactor: 0.18-10 μm
- Samples are collected on Teflon filters for elemental analysis (XRF)

Sampling Equipment – Direct-Reading Aerosol Instruments

Optical size spectrometry:

- Portable Dust Monitor (1.108, Grimm Aerosol Technik, Ainring, Germany)
- 15 size channels: 0.30 - 20 μm

Tapered-Element Oscillating Microbalance :

- TEOM (1400a, R&P, Albany, NY, USA)
- Realtime PM2.5 mass concentration

Sampling Equipment - Meteo

- Wireless Vantage Pro weather station (6150, Davis Instruments, Baltimore, MD, USA)

- Recorded parameters:
  - temperature
  - relative humidity
  - wind speed
  - wind direction
  - precipitation
  - barometric pressure

PM2.5 Sampling Sites during 2002

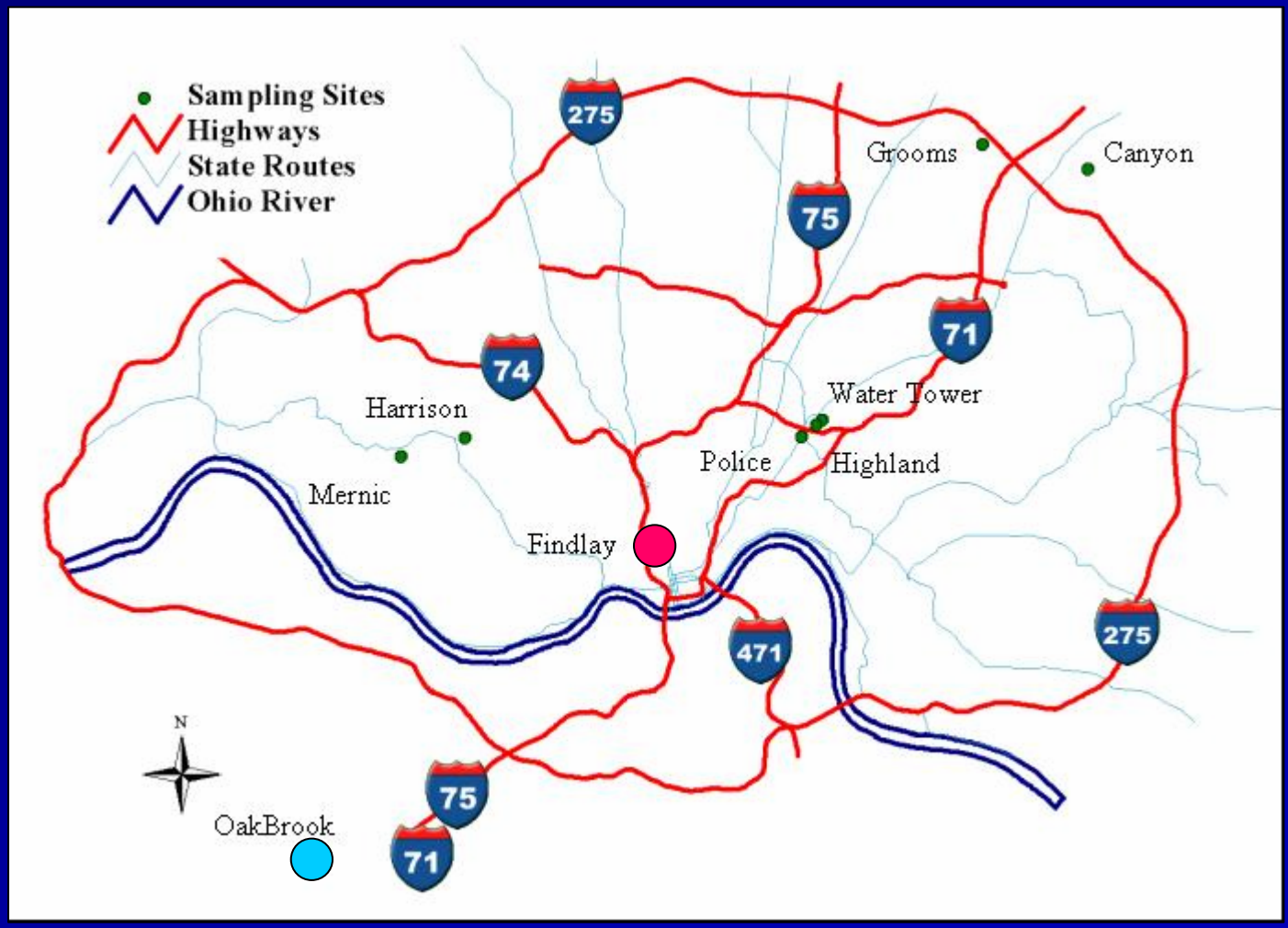
Site Number	Name	Proximity to other pollution sources	Inside/Outside the highway corridor	Distance from a highway, m
1	Police	State route, industry	Inside	280
2	Highland	Industry	Inside	320
3	Water Tower	Industry	Inside	510
4	Canyon		Outside	1800
5	Grooms		Inside	350
6	Findlay	Street traffic	Inside	**210**
7	Harrison	State route	Outside	3000
8	Mernic		Outside	**4600**
9	Oak Brook		Outside	4500
10	Linn	Street traffic	Inside	300
11	Hays	Street traffic	Inside	320

Measurement Results

Category		WINTER		SPRING		SUMMER		AUTUMN	
		LE	HE	LE	HE	LE	HE	LE	HE
PM2.5, μg/m^3	Al	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NM	[illegible]
Crustal elements, ng/m^3	Mn / Si	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NM	[illegible]
Anthropogenic elements, ng/m^3	Ca / Fe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NM	[illegible]
	Ni	0.50 ±0.70	0.82 ±0.4	0.38 ±0.2	0.67 ±0.3	0.50 ±0.4	0.82 ±0.9	NM	0.63 ±0.3
	Zn	8.30 ±2.5	24.8 ±15	10.4 ±3.2	24.5 ±19	8.50 ±4.1	21.3 ±12	NM	24.8 ±13
	Pb	1.96 ±0.80	7.69 ±4.8	2.8 ±1.2	5.00 ±2.2	2.29 ±0.7	4.03 ±2.4	NM	4.28 ±1.8

- PM2.5 concentration is homogeneously distributed through the city, independently on the distance from the highways.
- In most cases, the concentration of crustal elements in PM2.5 is not significantly different in lower and higher exposure areas.
- Trace metal concentration is considerably higher (up to 8 times) in the vicinity of the highways.
- Sulphate concentration is considerably elevated and homogeneously distributed through the city. It is slightly higher in the vicinity of the highways.

Elemental versus Organic Carbon: TOT Method: EC/TC = EC/(EC+OC)



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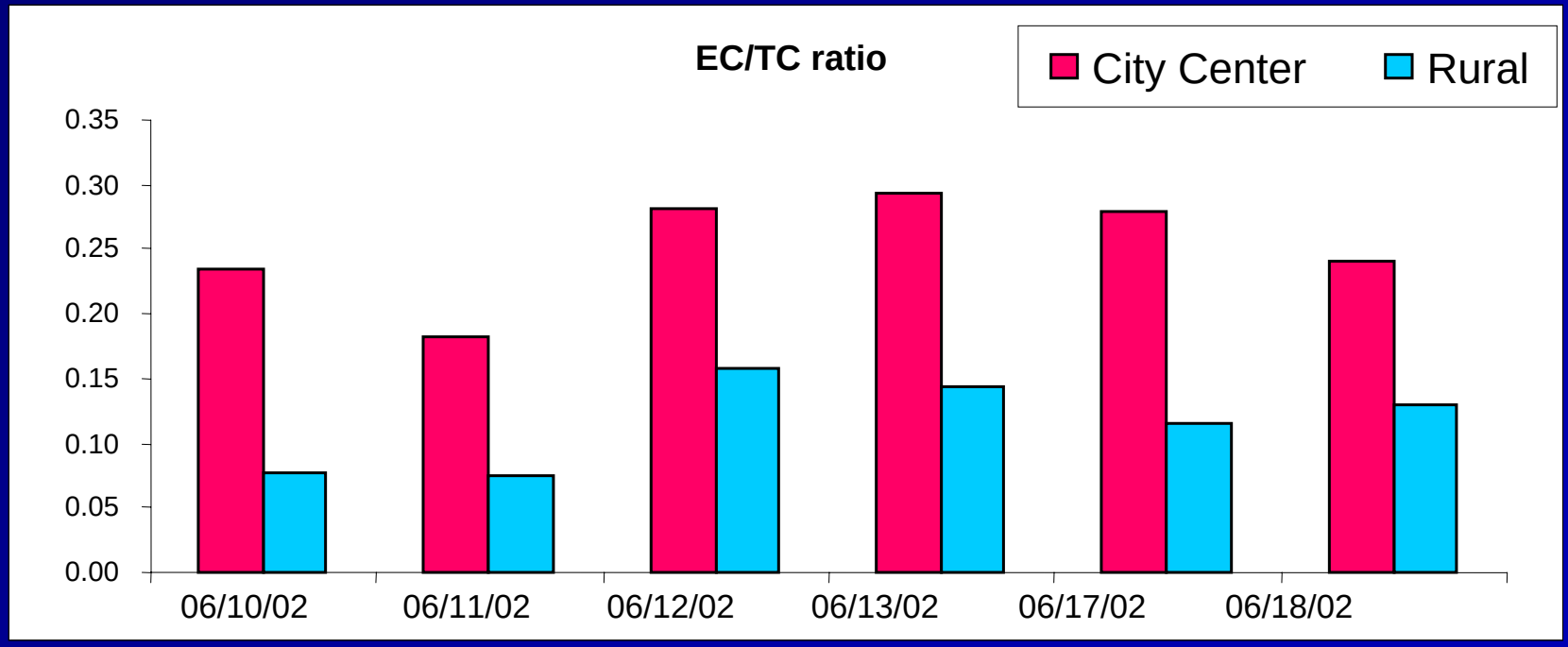
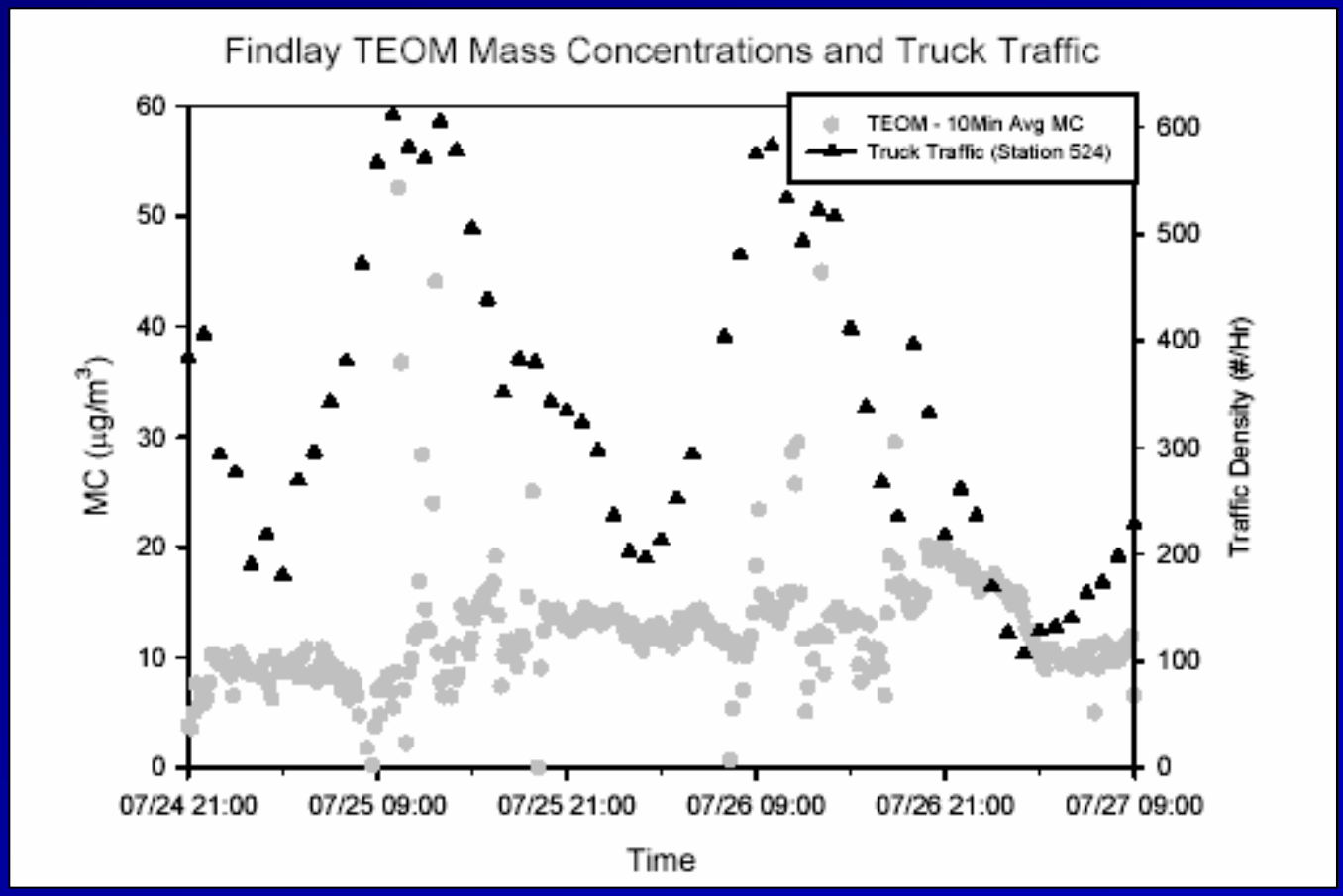


City Center: **Findlay**

Rural: **Oakbrook**

Real-Time Measurement:

PM2.5 Mass versus Traffic Intensity (Heavy-Duty Diesel Vehicles)

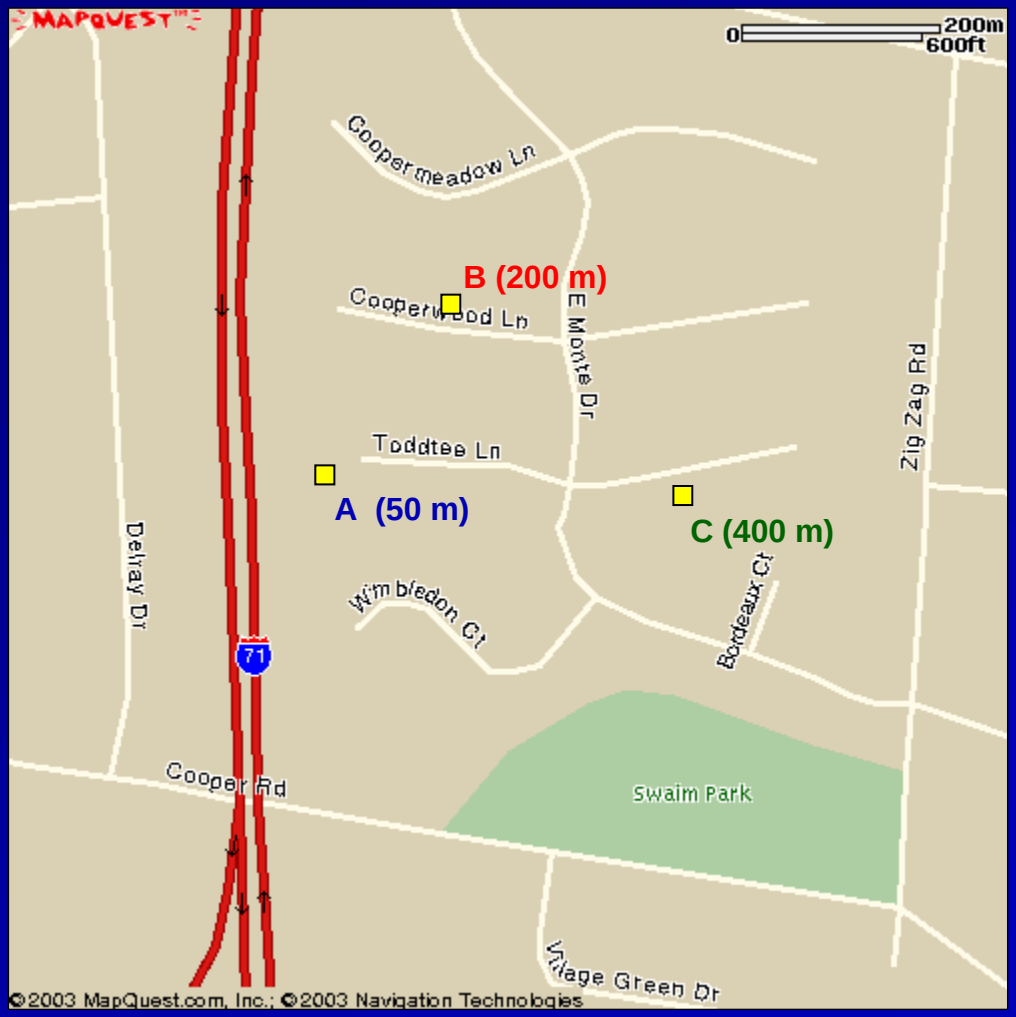


What is happening in a close vicinity of a highway?

COLLABORATORS:

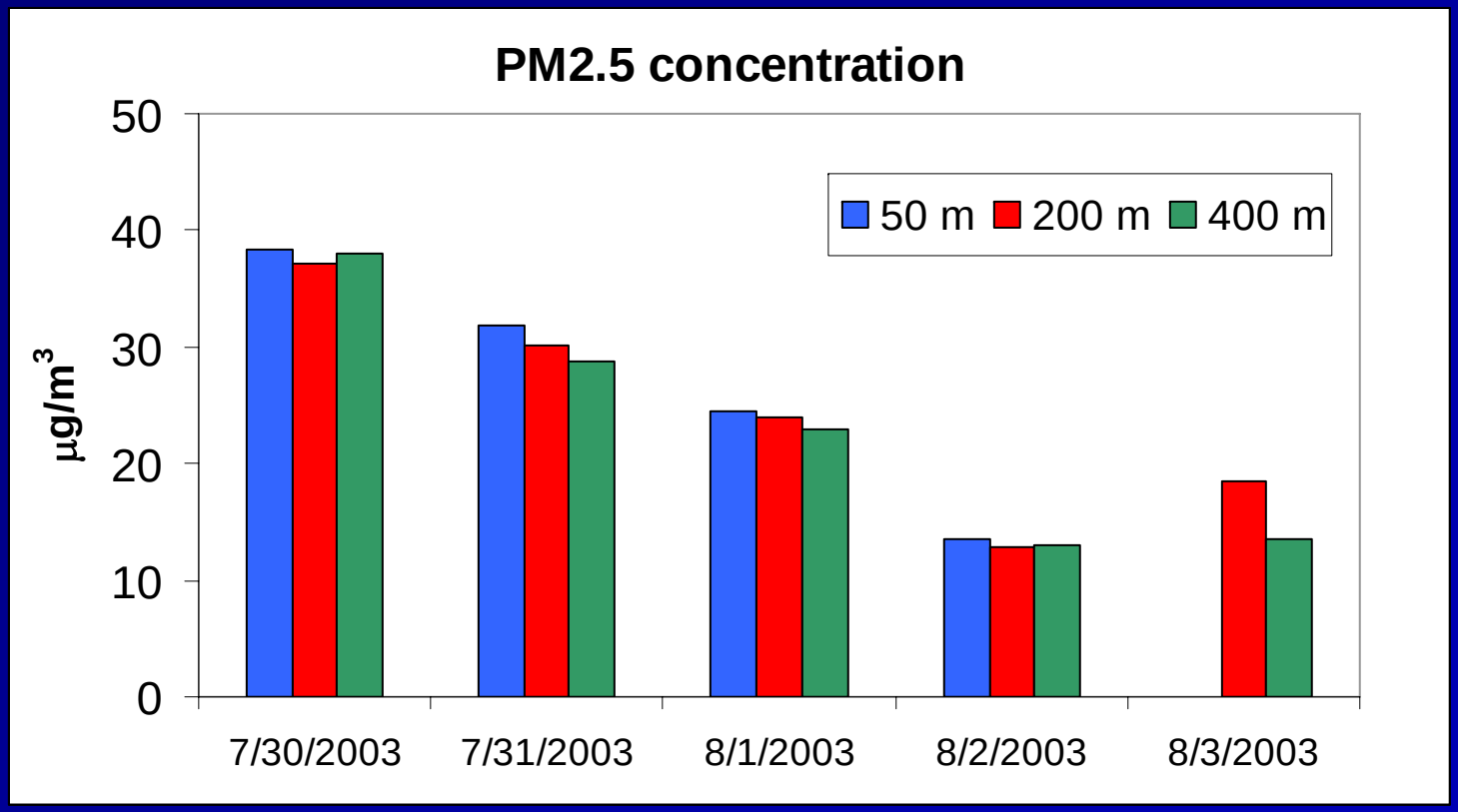
UNIVERSITY OF CINCINNATI
UNIVERSITY OF CALIFORNIA (DAVIS)
HC DEPT. ENVIRONMENTAL SERVICES

MEASUREMENT LOCATION

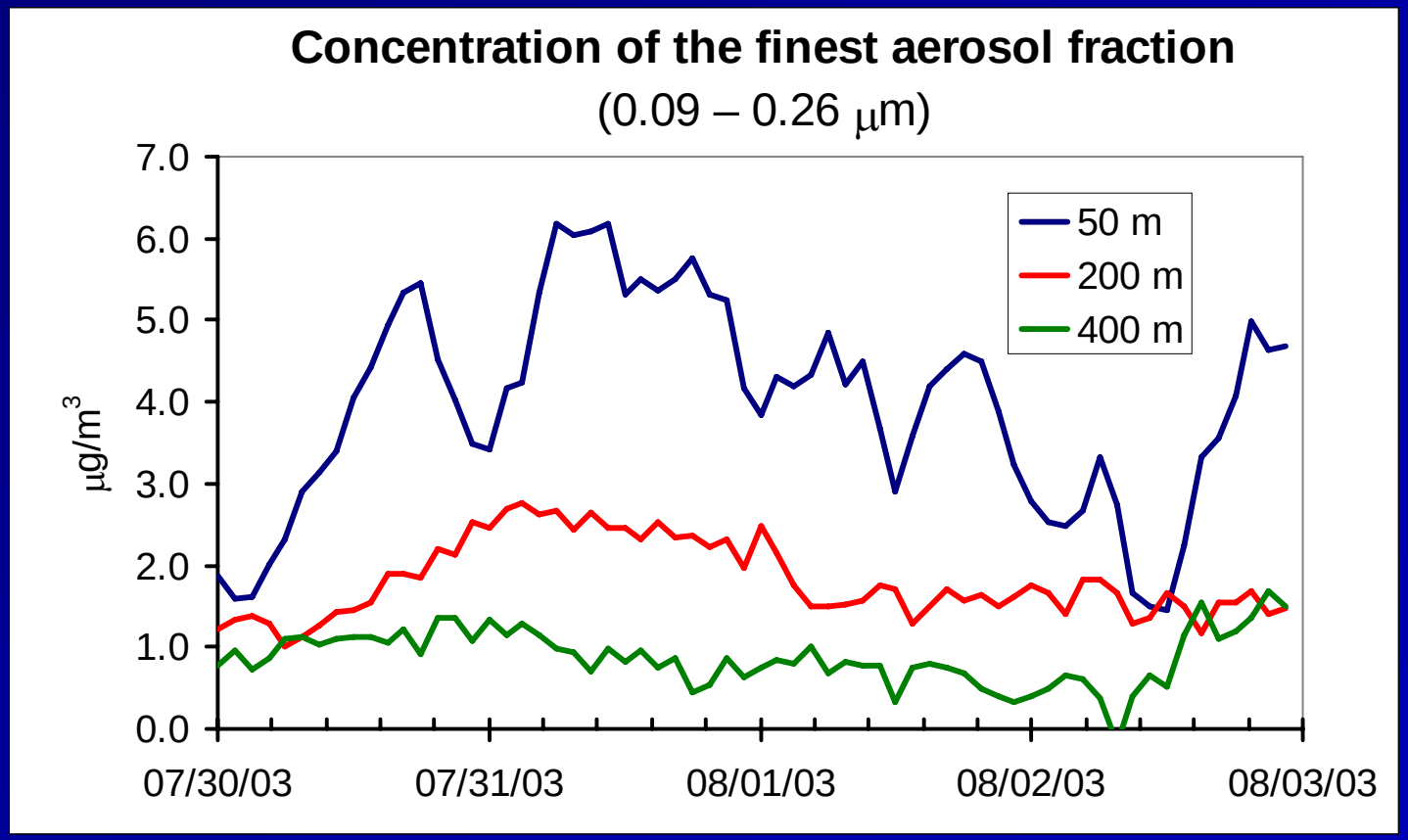


MEASUREMENT EQUIPMENT

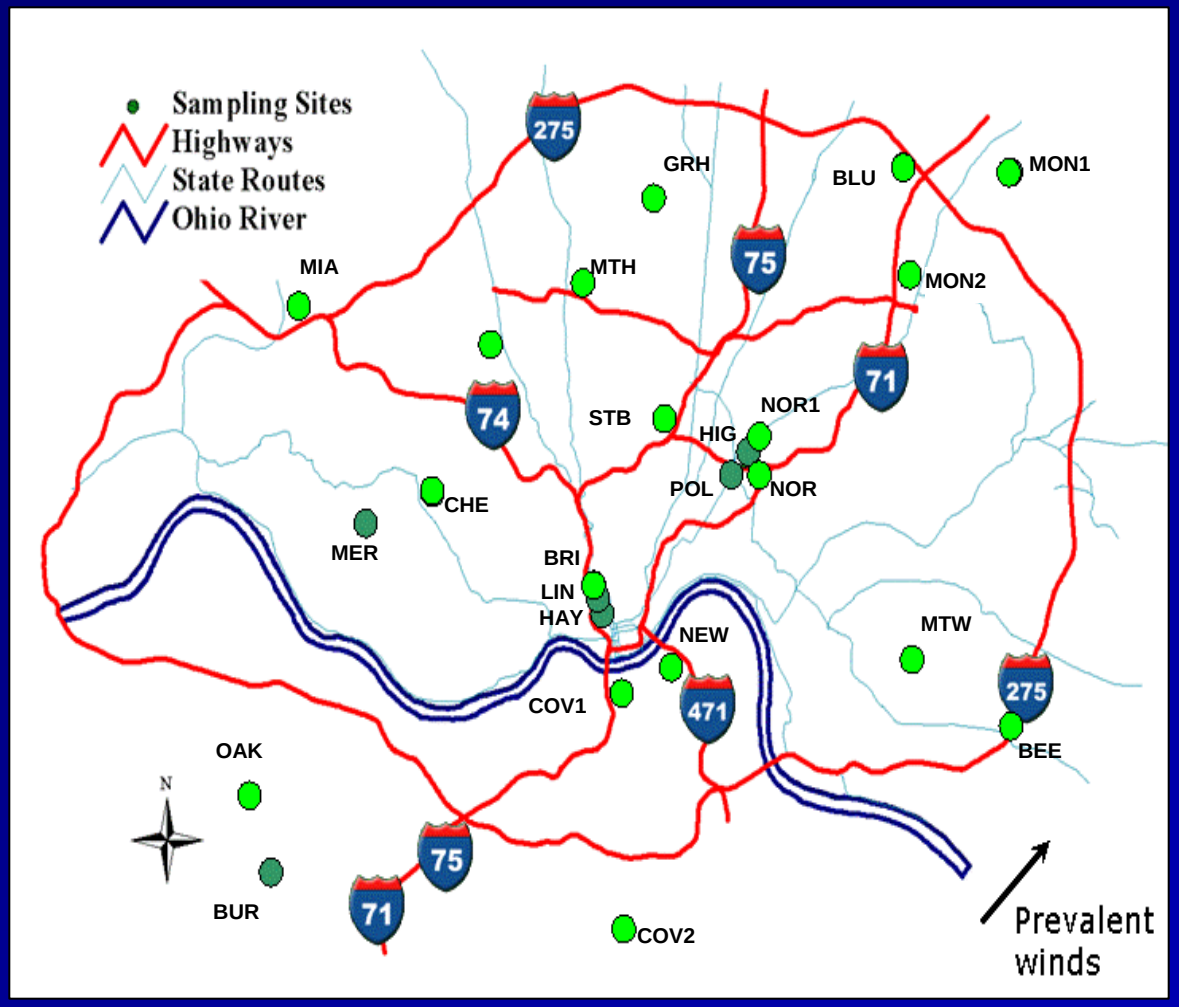
- Three 8-stage DRUM samplers (Delta group at UC-Davis):
  - Size- and time-resolved particulate matter mass and elemental concentration
  - Particle size range 0.09 – 0.26, 0.26 – 0.34, 0.34 – 0.56, 0.56 – 0.75, 0.75 – 1.1, 1.1 – 2.5, 2.5 – 5.0, 5.0 – 10.0 µm.
  - 1.5 hour time resolution


PM2.5 concentration
50
40
30
20
10
0
µg/m3
50 m
200 m
400 m
7/30/2003
7/31/2003
8/1/2003
8/2/2003
8/3/2003

The ultrafine and submicron fine fractions are effected by the distance from the source



CCAAPS PM2.5 monitoring network
(Greater Cincinnati – Northern Kentucky area).



TSCE levels (contribution to EC levels) at different locations. The TSCE values are averages over the number of runs indicated in "Number of Samples Collected" column.

Site Abb. (* =routinely used in CCAAPS)	Number of Samples Collected	Estimated Average Contribution to EC TSCE ($\mu g/m^3$)
STB*	16	1.185
LIN	7	1.110
BRI*	80	0.859
COV1*	6	0.534
NEW*	12	0.494
HAY	7	0.451
POL	8	0.407
MIA*	4	0.388
NOR2*	17	0.309
HIG	9	0.285
BLU*	56	0.284
NOR1*	32	0.255
MON2*	6	0.248
BEE*	8	0.243
CHE*	48	0.214
GRH*	22	0.198
MTH*	4	0.190
GRO*	6	0.188
MTW*	15	0.177
MER	8	0.166
BUR*	8	0.133
MON1*	37	0.117
OAK	13	0.106
COV2*	12	0.103

NEW STANDARDS FOR HEAVY-DUTY VEHICLES WILL BE IMPLEMENTED IN THE USA STARTING LATE 2006

We need to determine the effect of adopting and implementing the new heavy-duty engine and vehicle standards and the use new diesel fuel on the urban ambient DEP concentration.