CRUISER/Air Quality Studies

to better understand human exposures and observed health effects in the Windsor/Detroit region

Health Canada-US EPA
Workshop
October 21, 2005

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Environment Canada Environnement Canada

Canadian Regional & Urban Investigation System for Environmental Research

CRUISER's Visits to Windsor

Mobile Campaigns (2004):

- Oct. 21-22
- Oct. 27-29
- Nov. 9-12
- Nov. 16-19
- Dec. 14-16

Fixed Location Measurements (2005):

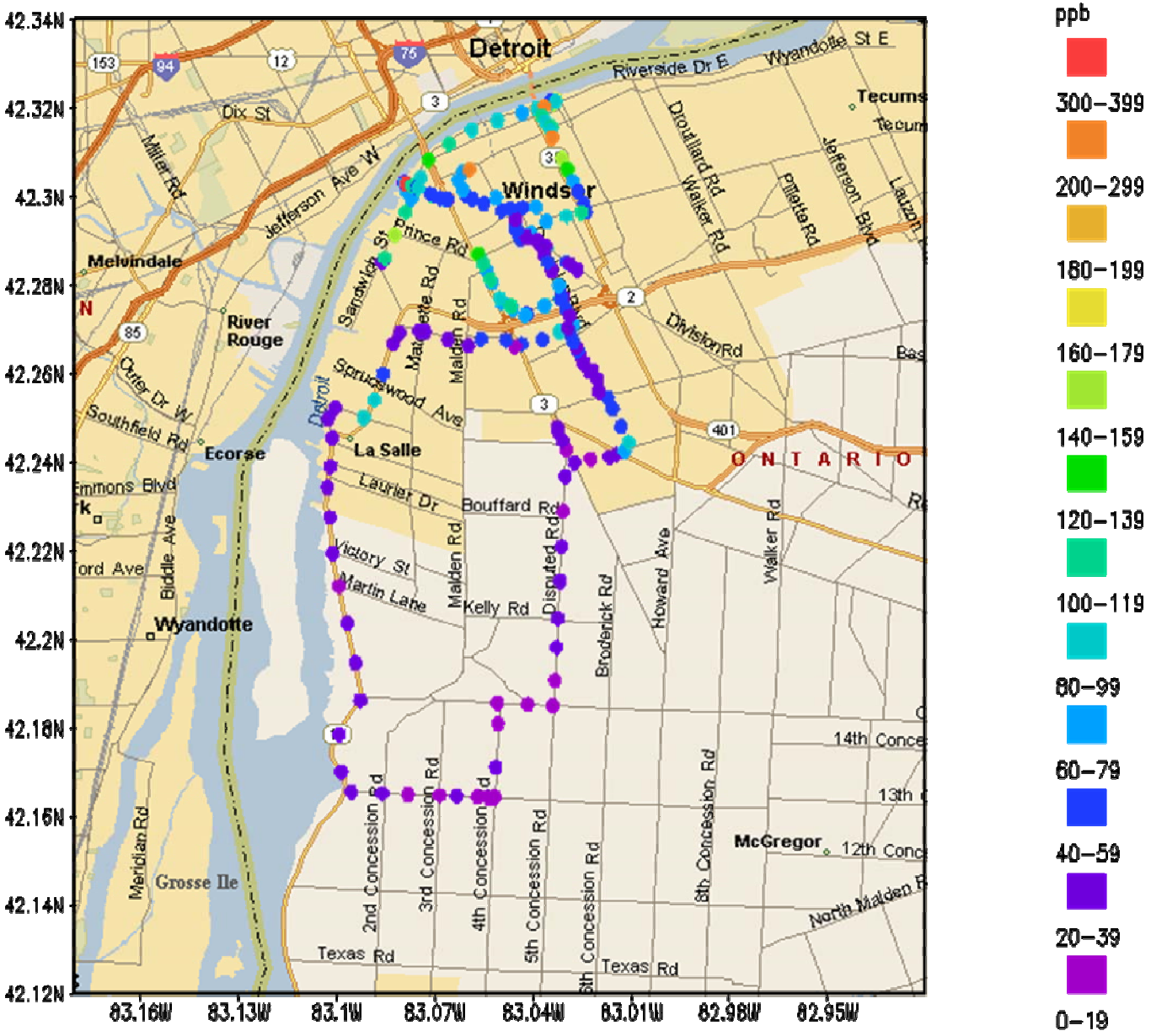
- Jan. 12-Feb. 1

Main Research Objectives

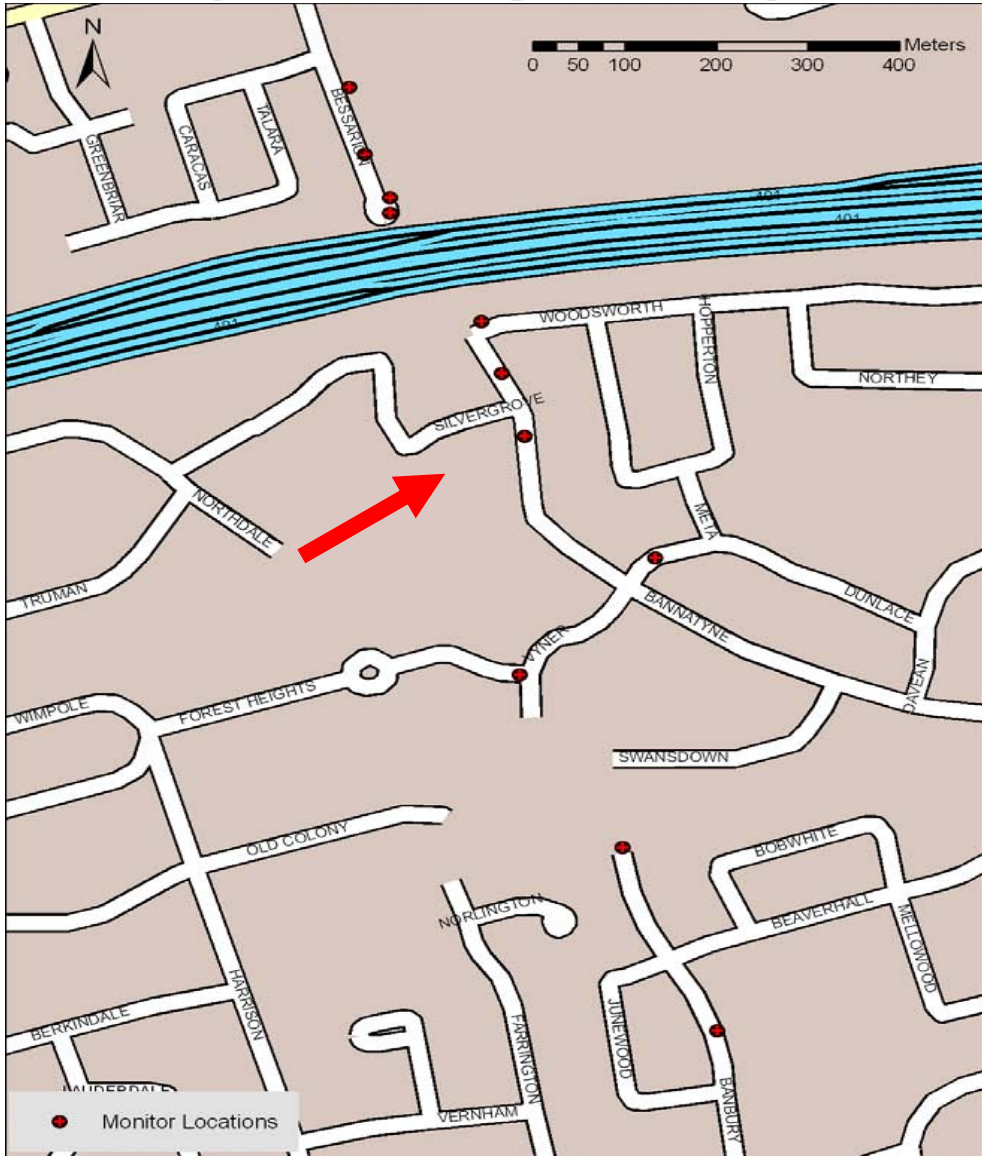
- Detailed characterization of urban-scale variability
  - Develop mobile measurement techniques
  - Evaluate and extend LUR
  - Spatial covariance of a larger suite of pollutants
  - Gradients in the vicinity of hot spots
- Improve source apportionment capabilities
  - Develop urban-scale capabilities
  - Reduce time required to identify sources influencing a neighbourhood
- Exposure to SVOC/OC compounds and EC
  - TD-GCMS
  - Linkage to vehicular emissions

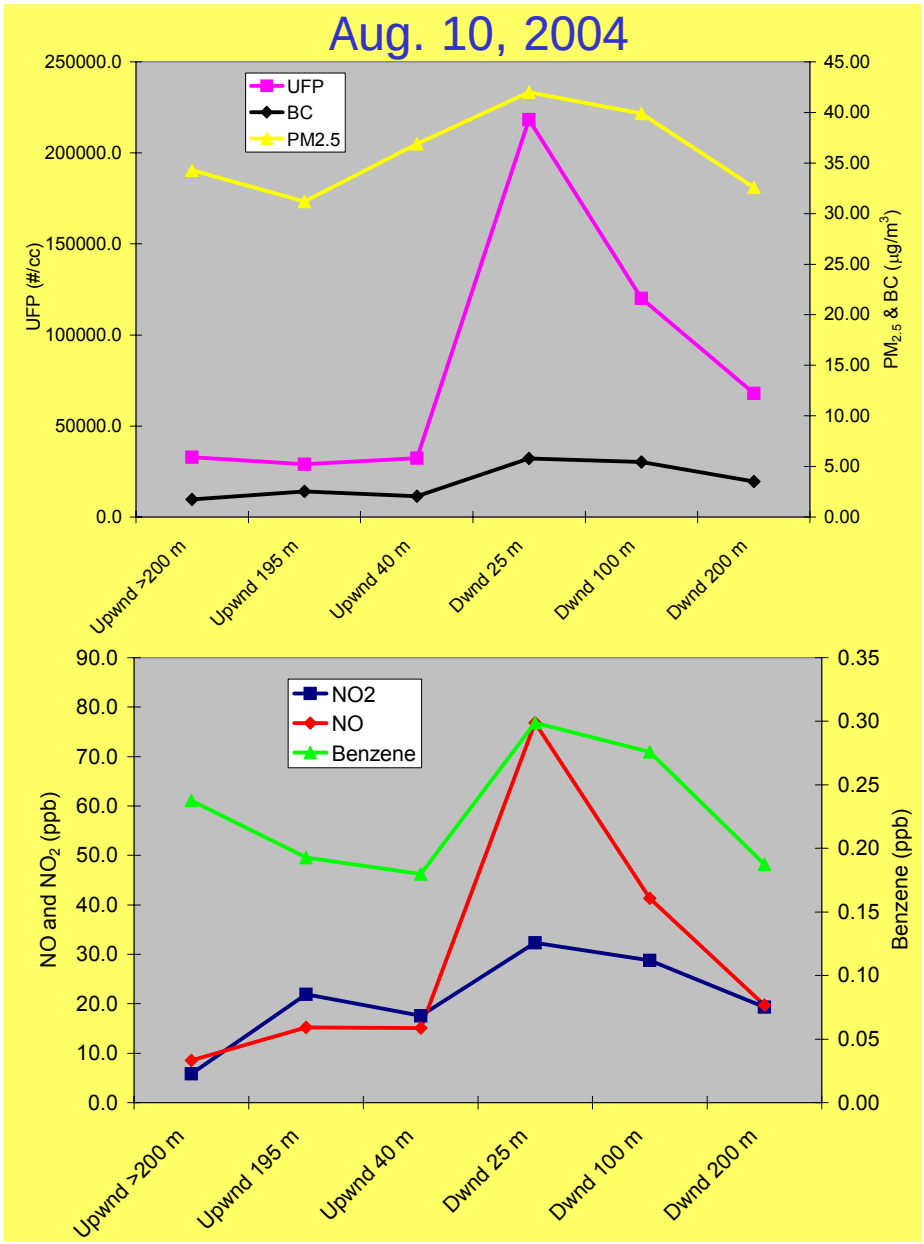
Mobile Mapping for Exposure

Example of NO_x Across W. Windsor



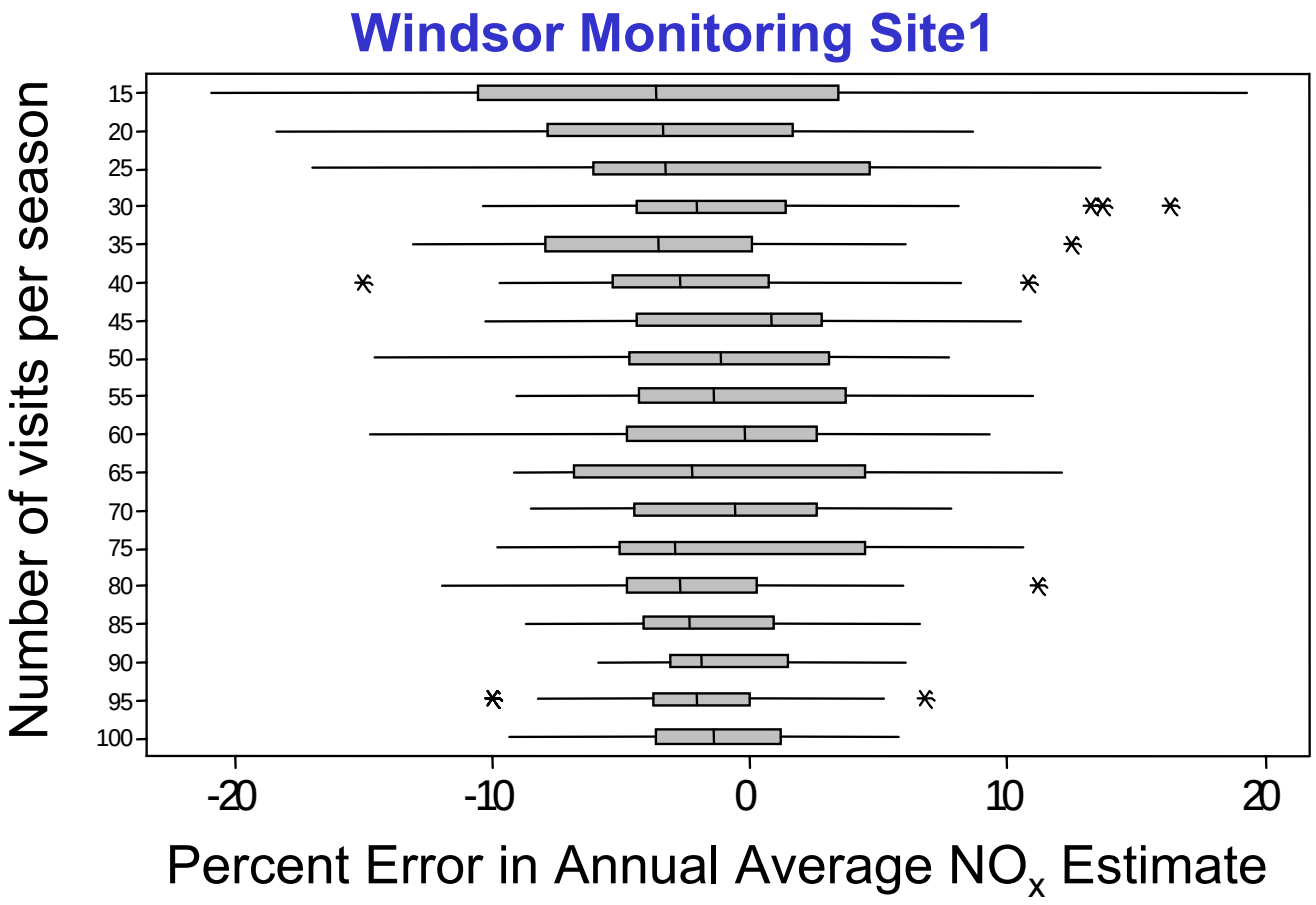
Neighbourhoods Up&Downwind of Major Highway





Error in Estimate of Annual Average vs. Number of Visits

CRUISER can't be everywhere all the time



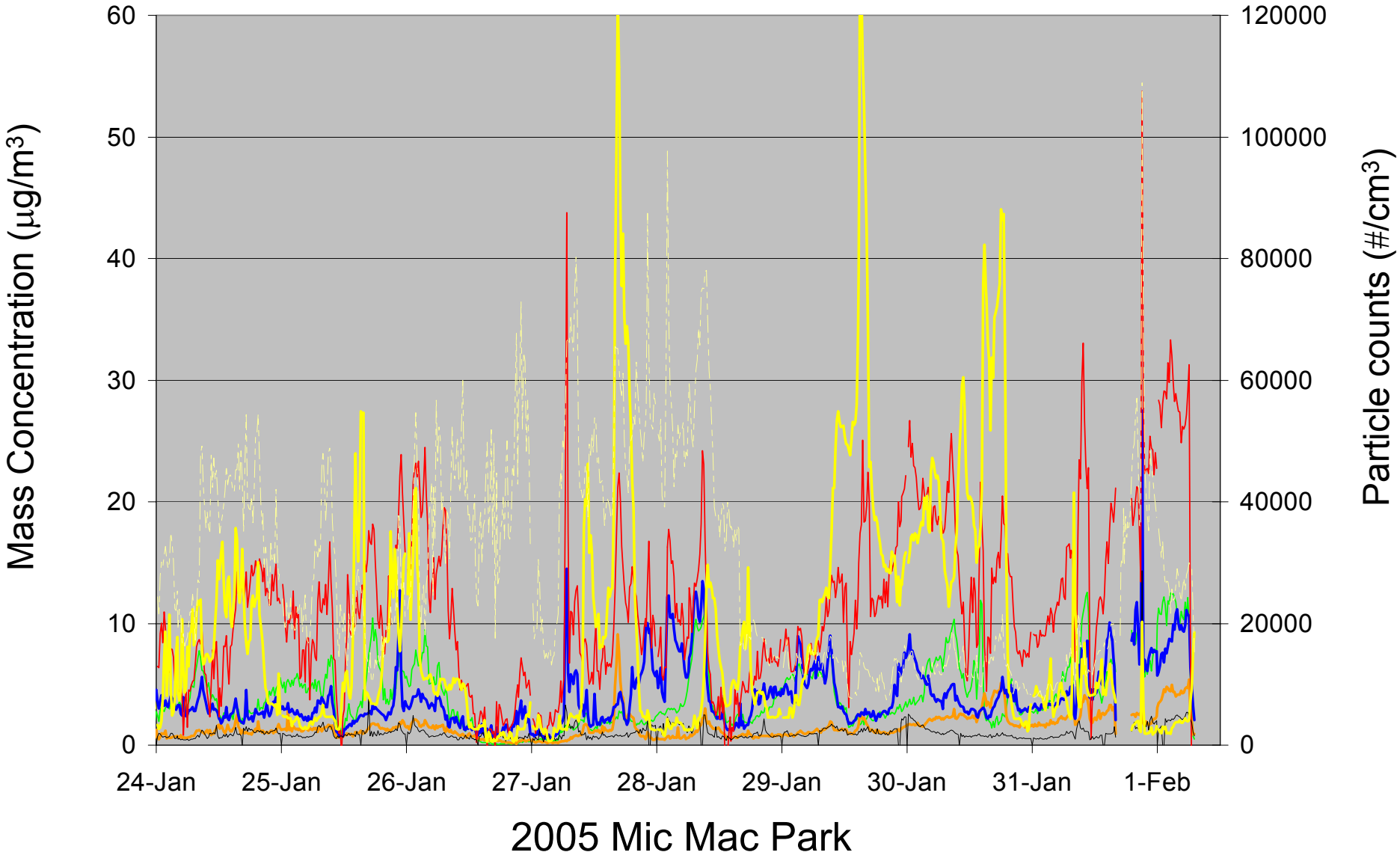
Mic Mac Park Jan-Feb. 2005

- Windsor dataset for receptor model development

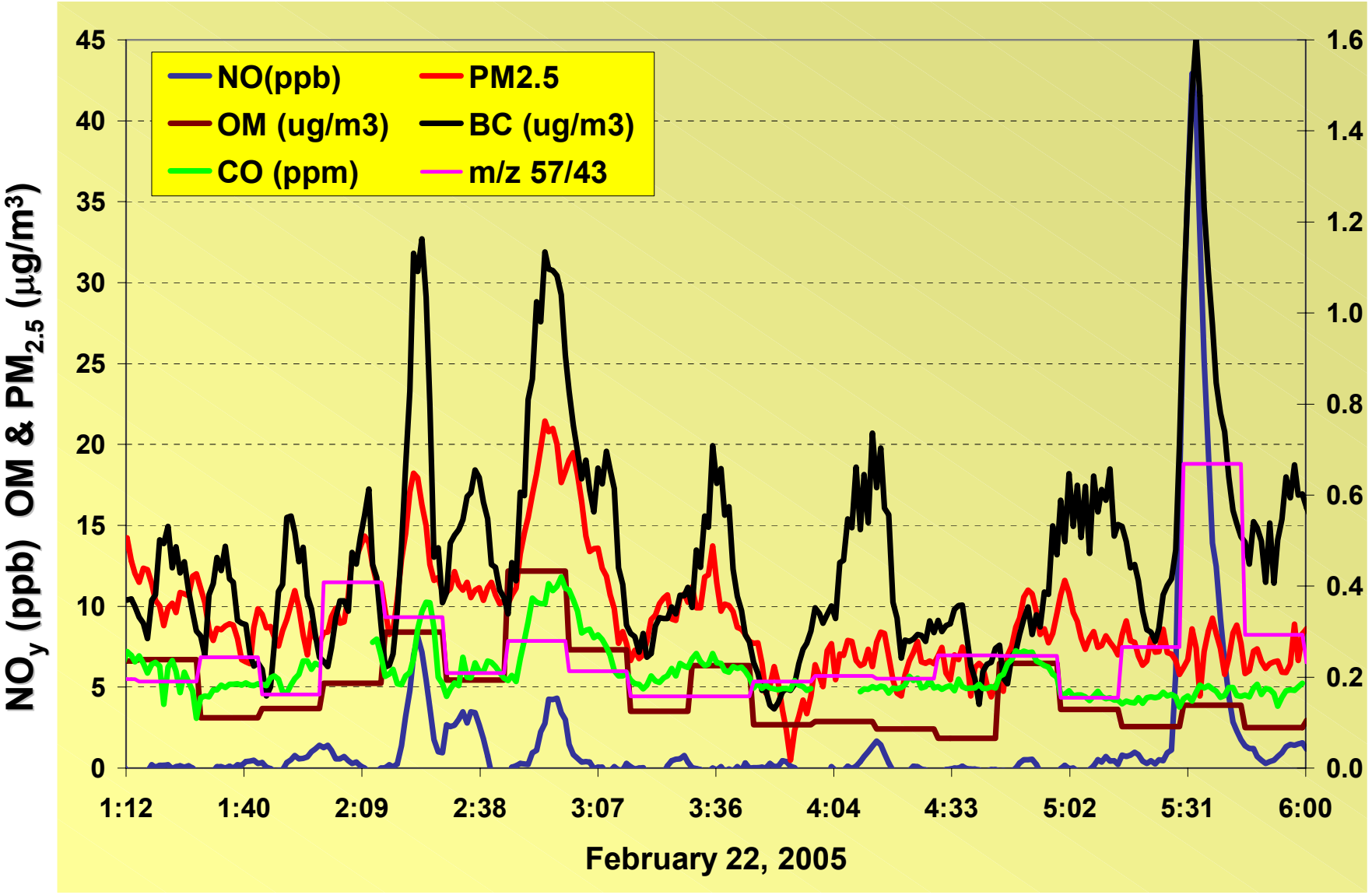
- **Semi-continuous Elements in Aerosol System (SEAS)**
  Special study of time-resolved metals

Fixed-Site Intensive: West Windsor

5-30 minute $PM_{2.5}$ data



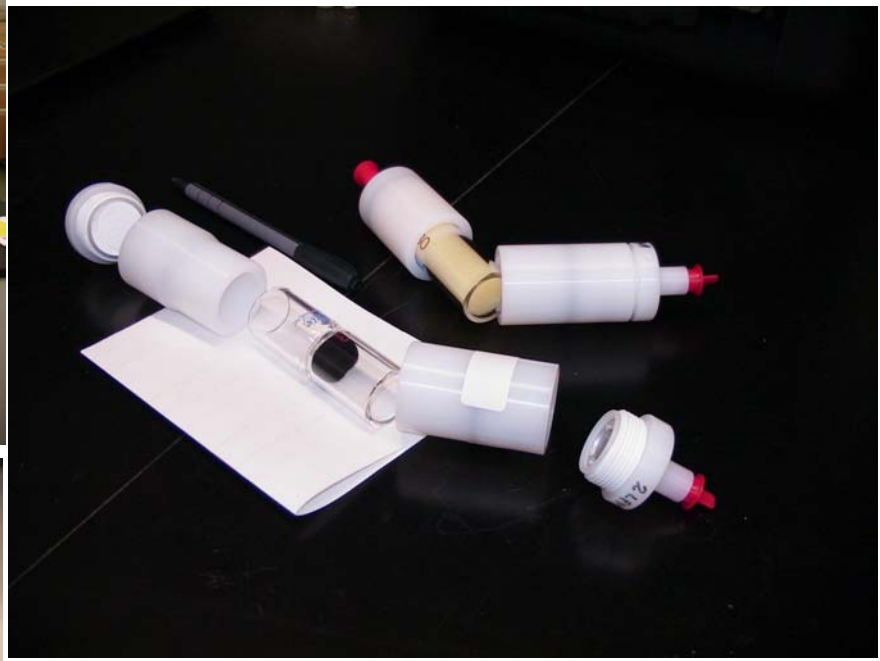
Two sources during a relatively short time period



NVOC, SVOC & VOC Sampling and Analytical Method Development

TD-GCMS

OC/EC



Standard and modified URG Personal Pesticide Sampler using Carbon-Impregnated Foam

1-2 week integrated samples at

~50 pts in Windsor

Future extension to personal exposure

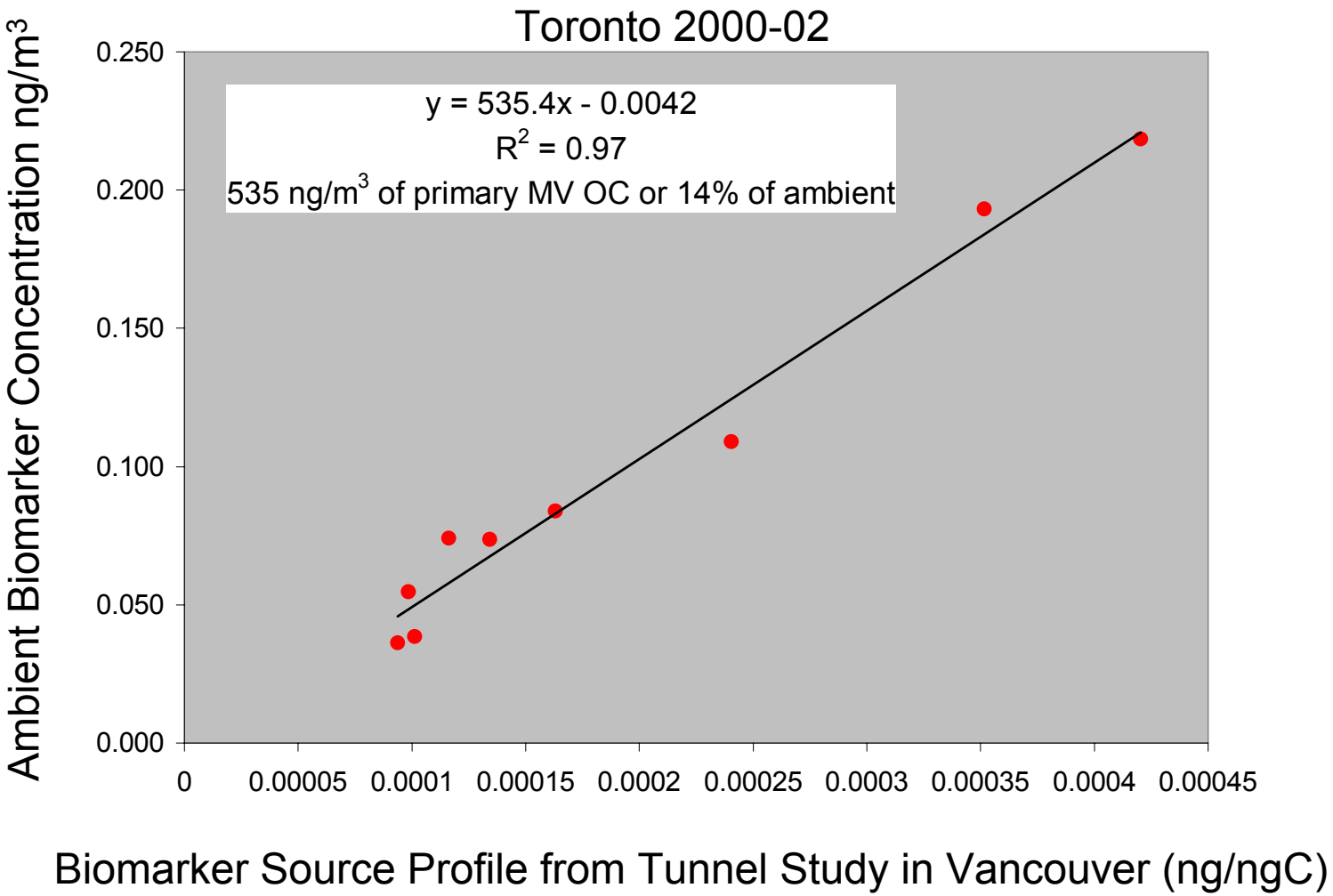
Quantification of Organics

		RT (min)	RT-RSD (%)	Calibration Range (ng)			#Cal	R^2	RSD (%)	DL (ng)	Conc. (ng/m^3)	Vap. Press.
	PAHs											
4	Naphthalene	14.18	0.00	0.0989	--	1.582	4	0.998	14.7	0.049	0.155	1.563
10	Biphenyl	18.97	0.02	0.0485	--	0.194	3	1.000	15.1	0.039	0.040	0.559
15	Acenaphthylene	20.46	0.00	0.0541	--	0.216	3	1.000	12.5	0.027	0.015	
17	Acenaphthene	21.22	0.39	0.048	--	0.192	3	1.000	5.8	0.024	0.003	0.182
21	Fluorene	23.44	0.00	0.0204	--	0.651	5	1.000	16.9	0.012	0.015	-0.282
26	Dibenzothiophene	28.06	0.03	0.019	--	0.608	5	1.000	6.7	0.010	0.020	
27	Phenanthrene	28.69	0.02	0.0501	--	1.602	5	1.000	7.2	0.025	0.069	-1.098
28	Anthracene	29.08	0.02	0.0162	--	0.517	5	0.997	25.3	0.014	0.019	-1.138
36	4H-Cyclopenta[def]phenanthrene	32.68	0.01	0.0101	--	0.322	5	0.999	12.9	0.005	0.007	
42	Fluoranthene	36.71	0.00	0.036	--	1.152	5	0.999	5.1	0.018	0.179	-2.229
43	Pyrene	38.16	0.00	0.039	--	1.239	5	0.999	7.2	0.019	0.145	-2.266
53	Benzo[ghi]fluoranthene	45.60	0.00	0.015	--	0.472	5	1.000	7.0	0.007	0.053	
54	Benzo[c]phenanthrene	45.60	0.00	0.020	--	0.638	5	0.999	12.0	0.010	0.019	
57	Cyclopenta[cd]pyrene	47.18	0.01	0.008	--	0.271	5	0.999	34.0	0.004	0.023	
58	Benz[a]anthracene	47.05	0.00	0.019	--	0.611	5	0.999	34.7	0.010	0.053	-3.448
59	Triphenylene_and_chrysene	47.44	0.01	0.038	--	1.210	5	0.999	2.6	0.019	0.150	-3.773
69	Benzo[b]fluoranthene	54.78	0.04	0.034	--	1.088	5	0.993	29.9	0.017	0.177	-5.124
70	Benzo[k]fluoranthene	54.78	0.03	0.015	--	0.477	5	0.996	30.9	0.007	0.131	-5.046
71	Benzo[j]fluoranthene	54.78	0.05	0.018	--	0.574	5	0.986	37.1	0.009	0.067	
72	Benzo[a]fluoranthene	55.46	0.06	0.010	--	0.315	5	1.000	11.8	0.011	0.016	
75	Benzo[e]pyrene	56.25	0.03	0.020	--	0.631	5	0.996	9.0	0.010	0.041	
76	Benzo[a]pyrene	56.72	0.21	0.020	--	0.651	5	0.987	20.0	0.023	0.042	-5.228
78	Perylene	57.28	0.04	0.038	--	0.153	3	0.999	34.8	0.037	0.003	-5.314
89	Dibenz[a,j]anthracene	63.00	0.12	0.020	--	0.628	5	0.992	36.9	0.011	0.004	-6.465
90	Indeno[1,2,3-cd]pyrene	63.41	0.04	0.019	--	0.612	5	0.996	25.5	0.010	0.048	
91	D(ac)A_and_D(ah)A	63.79	0.17	0.032	--	1.033	5	0.996	28.1	0.016	0.008	-6.597
92	Benzo[b]chrysene	64.13	0.02	0.0177	--	0.566	5	0.989	72.1	0.013	0.006	
93	Picene	64.45	0.00	0.0282	--	0.113	3	0.996	59.2	0.014	0.013	
94	Benzo[ghi]perylene	64.54	0.16	0.0245	--	0.785	5	0.997	14.7	0.012	0.046	-6.370
97	Anthanthrene	65.28	0.07	0.0763	--	0.305	2	1.000	28.6	0.038	0.018	
102	Bibenzo[b,k]fluoranthene	70.64	0.10	0.0071	--	0.228	5	0.991	40.9	0.013	0.003	
103	Coronene	72.08	0.05	0.0098	--	0.312	5	0.999	27.3	0.010	0.007	-7.596
104	Dibenzo[a,e]pyrene	72.38	0.08	0.0197	--	0.315	5	1.000	94.0	0.019	0.005	
106	Dibenzo[a,h]pyrene	73.11	0.07	0.0504	--	0.403	3	0.995	87.5	0.055	0.017	

Organics

		RT (min)	RT-RSD (%)	Calibration Range (ng)			#Cal	R^2	RSD (%)	DL (ng)	Conc. (ng/m^3)	Vap. Press.
12	2,6-dimethylnaphthalene	19.44	0.03	0.027	--	0.108	3	1.000	10.3	0.014	0.013	
14	1,6-Dimethylnaphthalene	19.85	0.03	0.028	--	0.111	3	1.000	9.8	0.014	0.019	0.378
16	1,2-Dimethylnaphthalene	20.61	0.03	0.034	--	0.138	3	1.000	2.8	0.017	0.014	0.287
32	3-Methylphenanthrene	31.95	0.02	0.018	--	0.591	5	1.000	9.0	0.009	0.016	
33	2-Methylphenanthrene	32.09	0.02	0.021	--	0.663	4	0.999	8.9	0.010	0.026	
34	2-Methylanthracene	32.50	0.02	0.012	--	0.000	5	1.000	16.9	0.017	0.005	
37	9-Methylphenanthrene	32.79	0.02	0.020	--	0.633	5	0.999	7.7	0.010	0.016	
38	1-Methylphenanthrene	32.79	0.02	0.019	--	0.621	5	0.999	5.9	0.010	0.014	-1.732
41	1,7-Dimethylphenanthrene	36.24	0.03	0.017	--	0.543	5	0.999	4.9	0.008	0.024	
47	(3- and 1-) Methylfluoranthene	40.88	0.12	0.020	--	0.638	5	0.999	5.7	0.010	0.017	-0.867
48	Retene	41.23	0.00	0.018	--	0.575	5	0.999	6.2	0.009	0.102	
50	4-Methylpyrene	42.20	0.00	0.009	--	0.284	5	0.999	10.4	0.004	0.015	
51	1-Methylpyrene	42.39	0.00	0.009	--	0.301	5	0.998	21.9	0.005	0.009	
62	3-Methylchrysene	50.48	0.01	0.010	--	0.313	5	0.998	7.5	0.005	0.028	
64	6-Methylchrysene	51.01	0.02	0.010	--	0.332	5	0.998	9.1	0.005	0.005	
	OPAHs				--							
13	1,4-Naphthoquinone	19.64	0.02	0.0505	--	0.202	3	0.914	44.1	0.025	0.059	-0.208
19	Menadione	21.93	0.00	0.0442	--	0.177	3	0.964	50.6	0.071	0.122	-0.693
25	9-Fluorenone	27.60	0.02	0.035	--	1.117	5	0.998	1.6	0.017	0.083	-1.534
31	Acenaphthenequinone	32.48	0.01	0.028	--	0.881	5	1.000	6.0	0.014	0.607	-1.933
39	Anthraquinone	34.16	0.00	0.027	--	0.867	5	1.000	10.3	0.014	0.898	-2.332
46	Phenanthrenequinone	39.98	0.02	0.1136	--	0.909	3	0.999	130.3	0.057	8.256	-3.045
60	Benzanthrone	48.23	0.01	0.021	--	0.686	5	1.000	23.4	0.011	0.373	-4.115
63	Benz(a)anthracene-7,12-dione	50.65	0.01	0.023	--	0.748	5	0.999	20.2	0.012	0.176	-4.452
66	1,4-Chrysenequinone	52.23	0.02	0.0248	--	0.795	5	0.995	109.0	0.049	0.197	-4.672
	Hopanes		0.02									
79	17a(H),21b(H)-22,29,30-trisnorhopane	58.19	0.02	0.032	--	1.033	5	0.998	10.3	0.016	0.004	
85	17a(H),21b(H)-30-norhopane	61.18	0.01	0.009	--	0.287	5	0.999	43.0	0.024	0.221	
88	17a(H),21b(H)-30-hopane	63.00	0.01	0.012	--	0.393	5	0.995	30.0	0.006	0.147	
96	17a(H),21b(H)-22S-homohopane	65.11	0.01	0.022	--	0.354	5	0.999	26.6	0.011	0.106	
98	17a(H),21b(H)-22R-homohopane	65.37		0.025	--	0.200	3	0.995	28.7	0.012	0.086	
	Steranes				--							
73	C27-20S5a(H),14b(H),17b(H)-chlolestar	56.22	0.02	0.074	--	2.357	5	0.996	5.3	0.037	0.029	
77	C27-20R5a(H),14a(H),17a(H)-chlolestar	56.91	0.01	0.235	--	7.534	5	0.998	8.0	0.118	0.016	
80	abb-20R-24S-methylcholestane	58.51	0.02	0.017	--	0.529	5	0.997	7.5	0.008	0.024	
83	aaa-20R-24R-ethylcholestane	60.36	0.11	0.058	--	1.866	5	0.995	3.5	0.029	0.138	
86	abb-20R-24R-ethylcholestane	61.27	0.02	0.028	--	0.893	5	0.993	3.4	0.014	0.019	

Apportionment of OC to Motor Vehicle Exhaust



New Activities

PM Collection for in vitro toxicity

- Size vs. location vs. composition vs. source
- In vitro model of pulmonary artery response

Ontario Ministry of the Environment Sampling

- MOE mobile labs in Windsor this month
- Future coordination with CRUISER

CRUISER Campaigns (2006-07):

- Windsor
- Detroit (?)

Relative Toxicity Size-Fractionated PM from Different Windsor Locations

R&P – Chemvol to collect: $PM_{2.5-10}$; $PM_{0.5-2.5}$; $PM_{0.1-0.5}$; $PM_{0.1}$ when local sources are anticipated to dominate the PM over Windsor

- Heavy Industry w/ 'Rouge influence' : West Windsor (in progress)
- Border Traffic : U of Windsor (next location)
- ~4 other 'unique' locations to be visited


UNION
SUNSET
COLLEGE
5
4
Tree
Trailer and
Outlet
Tripod
Railway
0
57 m

Thank You !

Thanks to:

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- Amanda Wheeler, Dalibor Breznan, Renaud Vincent
- Michael Hays (USEPA)
- City of Windsor
- Ontario MOE

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