EPA Science Forum 2003

Partnering to Protect Human Health and the Environment

Specific Health Effects in Healthy Highway Patrol Officers

Association of Exposure to Particulate Matter and Related Air Pollutants

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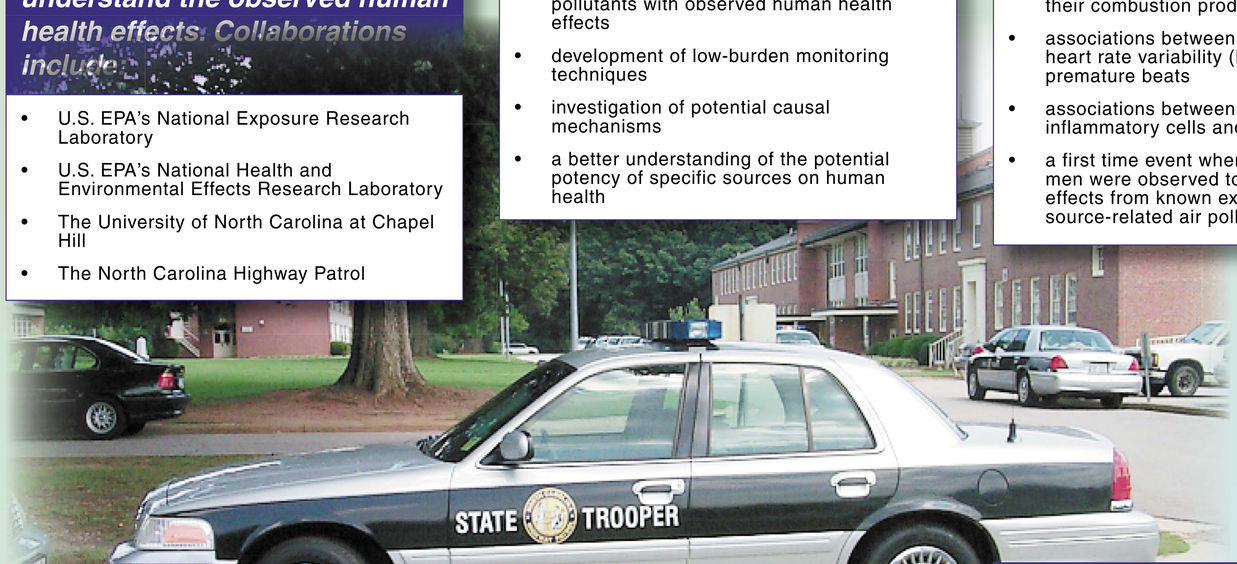
Moving Science into Action

The ORD is collaborating with multiple institutions to advance particulate matter and air toxics exposure research to better understand the observed human health effects. Collaborations include:

- U.S. EPA's National Exposure Research Laboratory
- U.S. EPA's National Health and Environmental Effects Research Laboratory
- The University of North Carolina at Chapel Hill
- The North Carolina Highway Patrol

Integrated exposure-epidemiological measurements have permitted:

- investigation of source-specific air pollutants with observed human health effects
- development of low-burden monitoring techniques
- investigation of potential causal mechanisms
- a better understanding of the potential potency of specific sources on human health



Resulting in:

- $PM_{2.5}$ levels were observed to be lower in vehicles than ambient and roadside levels
- in-vehicle aerosols appeared to be enriched in components related to motor fuels and/or their combustion products
- associations between $PM_{2.5}$ inside cars and heart rate variability (HRV) and numbers of premature beats
- associations between $PM_{2.5}$ with inflammatory cells and markers in blood
- a first time event where healthy, fit adult men were observed to have adverse health effects from known exposures to mobile source-related air pollutants

Impacting America by:

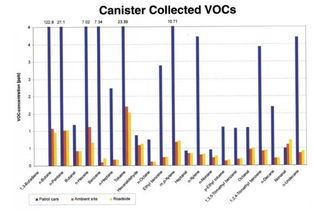
- performing direct human exposure measurements on susceptible subpopulations
- answering the most important human health questions involving sources of exposures
- developing and validating integrated exposure/health effect measurements
- directly supporting the science needed to address risk uncertainties

Exposure Findings:

Daily Pollutant Monitoring Summary

Location	Units	CO ppm	pDR µg/m3	PEM µg/m3	EC µg/m3	NO_2 ppb	Ozone ppb	PAH ng/m3
Patrol cars	Mean	2.6	24.1	23.0	2.3	41.7	11.7	21.5
	STD	1.1	14.6	10.8	0.8	83.3	15.9	10.3
	Min	0.7	4.4	6.8	1.1	1.6	-4.6	7.3
	Max	5.9	54.4	58.7	5.0	548.5	69.9	63.9
Ambient	Mean	0.8	35.4	31.7	1.7	30.4	34.2	--
	STD	0.3	25.3	13.8	0.7	17.1	29.7	--
	Min	0.3	3.9	9.9	0.6	9.4	0.0	--
	Max	1.5	96.0	68.9	3.7	69.5	132.4	--
Roadside	Mean	1.1	30.9	29.9	4.0	49.9	22.8	--
	STD	0.3	22.6	12.7	1.4	37.2	13.3	--
	Min	0.4	5.8	8.9	1.1	13.0	3.5	--
	Max	1.7	78.3	62.3	6.6	212.1	63.9	--
p-values	car/ambient	**0.000**	0.114	**0.006**	**0.001**	0.241	**0.000**	--
	car/roadside	**0.000**	0.361	**0.024**	**0.000**	**0.000**	**0.000**	--
	ambient/road	**0.013**	0.503	0.782	**0.000**	**0.006**	0.103	--

Canister Collected VOCs

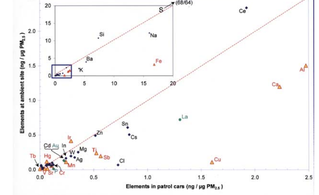


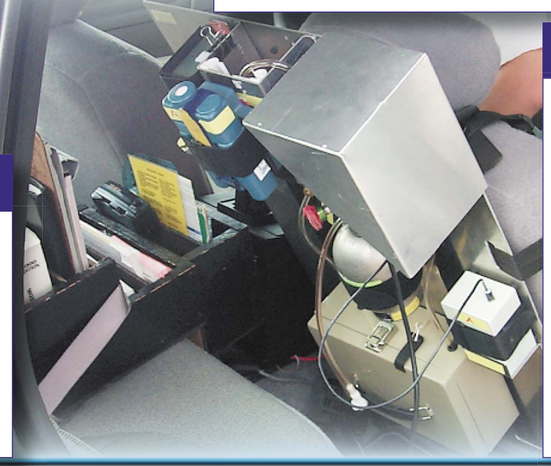
Daily Carbonyl and VOC Summary

Parameter	Units	Patrol cars Mean	STD	Min	Max	Ambient site Mean	STD	Min	Max	Roadside Mean	STD	Min	Max
Aldehydes	µg/m³	38.1	17.1	0.0	89.7	13.7	5.1	2.8	22.1	12.6	5.8	0.0	25.2
C4 to C11 n-Alkanes	ppb	33.2	54.9	5.1	335.8	4.3	3.1	1.6	13.3	3.9	2.1	1.1	10.8
Benzene	ppb	4.0	3.2	0.4	13.5	0.1	0.2	0.0	0.6	0.2	0.3	0.0	0.8
Toluene	ppb	10.4	20.2	2.3	130.8	1.7	0.9	0.8	4.7	1.5	0.7	0.6	3.3
Xylenes	ppb	4.5	2.0	1.4	12.1	1.0	0.5	0.4	2.4	1.0	0.4	0.4	1.9
Ethyl benzene	ppb	0.9	0.4	0.3	2.6	0.2	0.1	0.1	0.5	0.2	0.1	0.1	0.5
p-Ethyl toluene	ppb	0.4	0.2	0.1	1.1	0.1	0.1	0.0	0.4	0.2	0.1	0.0	0.4
Trimethyl benzenes	ppb	2.0	0.8	0.7	4.1	0.6	0.3	0.3	1.7	0.6	0.2	0.2	1.2

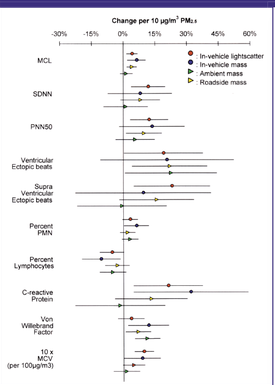
Patrol cars vs ambient or roadside p<0.001; no difference between roadside and ambient

Elemental Relationships





Health Finding:



Data from selected heart rhythm and blood parameters. Comparison of $PM_{2.5}$ effect estimates for two in-vehicle methods (diamonds) and for gravimetrical data from the ambient site and the roadside locations (arrows). Lines indicate the 95% confidence intervals of the effect estimates.

United States Environmental Protection Agency

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