Air Toxics Data Report

Air Toxics Monitoring Data Analysis Workshop

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Project Background

Community-Based Environmental Project

- Addressed environmental issues that traditional EPA programs do not typically address. EPA interacted with private and public sectors to build partnerships to achieve environmental results.
- The community addressed local environmental issues and defined EPA's role in the project. The community took actions through a wide array of voluntary, educational and/or regulatory activities.

Project History

Two Projects Become One Project

- EPA and MDNR viewed St. Louis City as the site of an initial Urban Air Toxics monitoring effort.
- EPA viewed St. Louis City as a CBEP community due to known or perceived environmental problems.
  - In the Fall of 1997, EPA sponsored a public outreach effort called the Listening Tour. Eighty-nine percent (89%) of the Listening Tour participants identified health-related air pollution concerns as the highest environmental priority.

Project Objectives

Primary Objectives of the St. Louis CAP

- To include community members and other interested stakeholders in a project that:
  - measured the ambient concentrations of hazardous air pollutants (HAPs) in a community airshed,
  - compared these ambient concentrations to health-based benchmarks, and
  - reduced these concentrations, if needed, in a manner acceptable to the community.

Project Tasks

Air Toxics Monitoring

- Determine an Analyte List
- Locate Ambient Air Monitoring Sites
- Derive Health-Based Benchmarks

Project Tasks

Determine an Analyte List

- EPA and MDNR used Cumulative Exposure Project maximum concentrations to estimate the ambient concentrations of the 188 HAPs within St. Louis City.
- EPA and MDNR compared these estimated ambient concentrations to the EPA Region IX Preliminary Remediation Goals (PRG).
- 77 of 188 HAPs had estimated ambient concentrations greater than a value equal to 0.0001(Region IX PRG).

Project Tasks

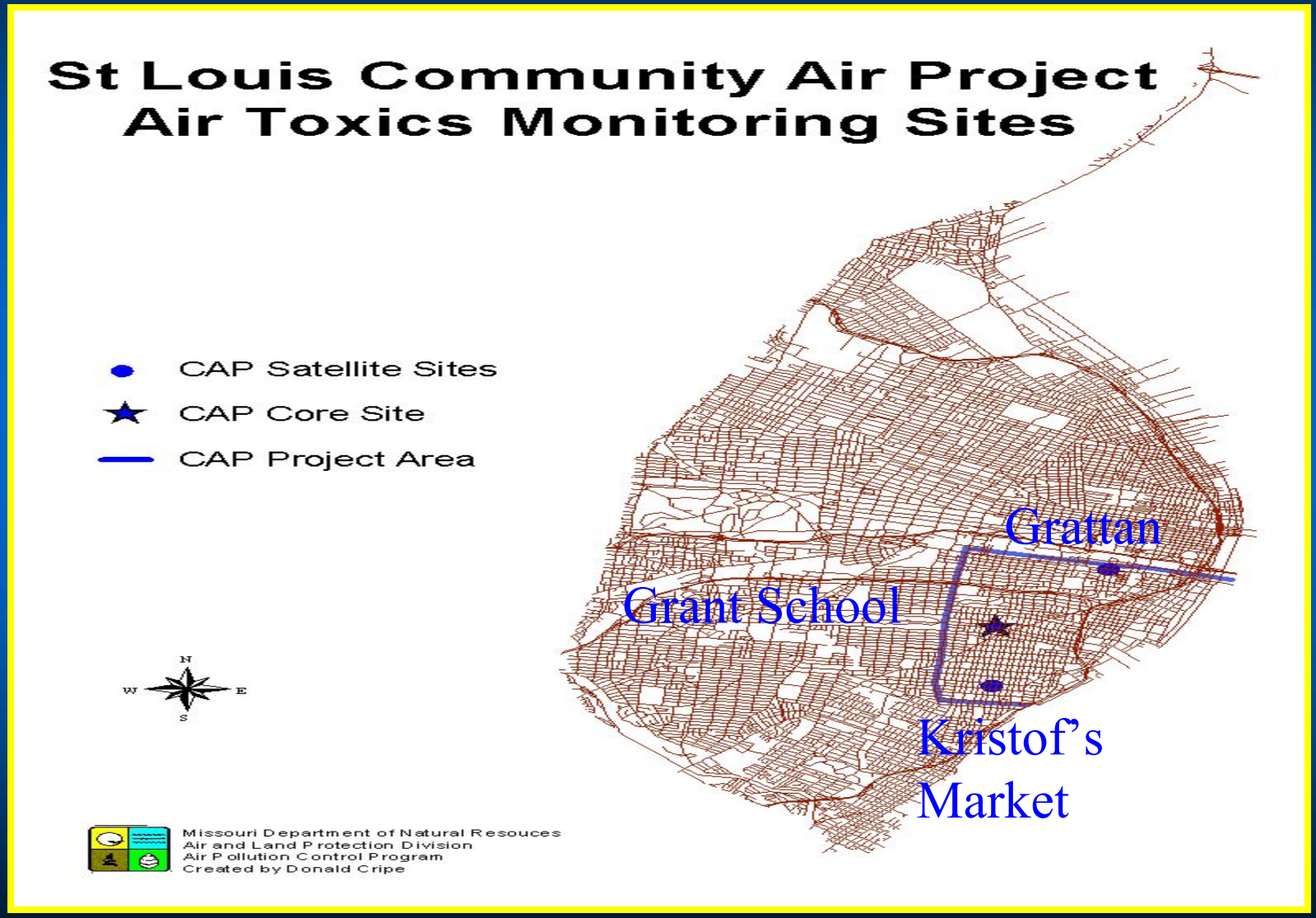
Determine an Analyte List

- EPA and MDNR removed 20 HAPs from the original list of 77 HAPs because of the lack of a reliable method or of the high cost of analysis.
- EPA and MDNR added 35 HAPs to the list of 57 HAPs because of no additional cost for analysis.
- The final analyte list contained 113 analytes, of which 104 were HAPs, plus diesel particulate matter (elemental carbon as a surrogate).

Project Study Area

St. Louis CAP
COMMUNITY AIR PROJECT

Project Study Area



St. Louis CAP
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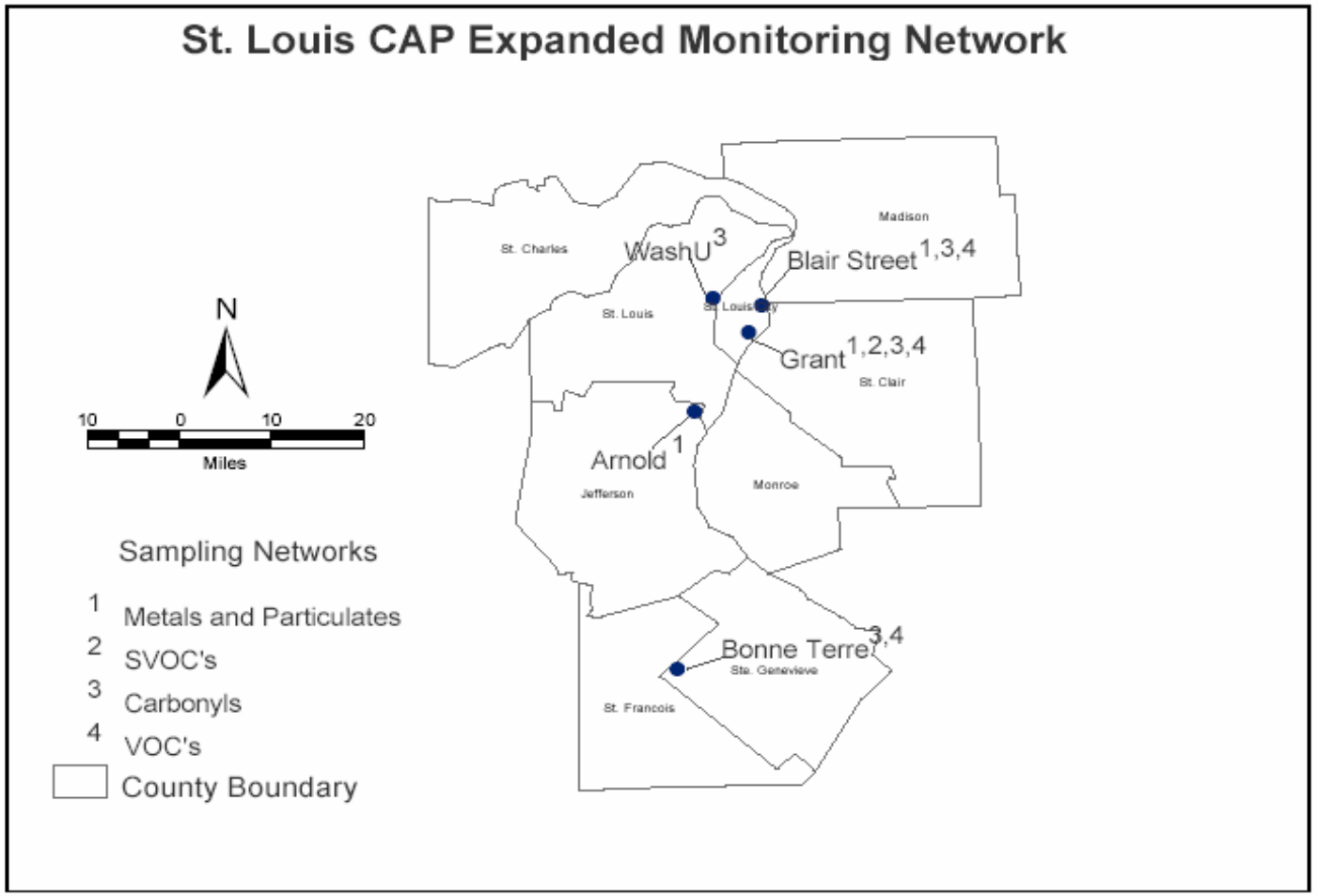
St. Louis Community Air Project

CAP Phase II Monitoring Sites



Project Tasks

Measuring Ambient Air Concentrations

- Sampling for volatile organic compounds occurred at the Grattan and Kristof's Market sites between May 13, 2001 and May 14, 2002.
- Sampling for volatile organic compounds, semi-volatile organic compounds, carbonyl compounds, metals, and dioxin (1 month) occurred at the Grant School site between May 13, 2001 and December 29, 2003.
- At all three sites, sampling occurred on a 24-hour, every 6-day schedule.

Project Tasks

Derive Health-Based Benchmarks

- The air concentration that is protective of public health over a lifetime of inhalation exposure.
- Derived using an EPA methodology.
  - separates benchmarks for potential cancer and non-cancer effects,
  - uses a tiered approach and an overall order of preference for data sources, and
  - bases benchmarks on best available toxicity data.

Project Tasks

Cancer Benchmarks

- The ambient air concentration representing an upper-bound excess lifetime cancer risk of one-in-one hundred thousand, assuming continuous exposure to the pollutant.
- The Partnership Team derived cancer benchmarks for 15-, 30-, and 70-year inhalation exposures.

Project Tasks

Cancer Benchmarks

- Data Hierarchy for Health-Based Benchmarks

Tier	Priority	Data Source	Toxicity Value
I	1	EPA	IRIS inhalation unit risk
II	2	CalEPA	Inhalation unit risk
III	3	EPA	HEAST inhalation unit risk

- Cancer benchmarks established for 61 of the 113 analytes.

Project Tasks

Non-cancer Benchmarks

- The ambient air concentration representing continuous inhalation exposure to the pollutant that is likely to be without appreciable risk of deleterious non-cancer health effects during a lifetime.

Project Tasks

Non-cancer Benchmarks

- Data Hierarchy for Health-Based Benchmarks

Tier	Priority	Data Source	Toxicity Value
I	1	EPA	IRIS Reference Concentration
II	2	ATSDR	Chronic Minimal Risk Level
II	3	CalEPA	Reference Exposure Level
III	4	EPA	HEAST Reference Concentration

- Non-cancer benchmarks established for 51 of the 113 analytes.

CAP Phases I and II Results

Ambient Air Concentrations

- None of the annual average ambient concentrations of the 113 analytes and diesel particulate matter were consistently greater than the respective non-cancer benchmarks. Yet the annual average ambient concentrations of five analytes were consistently greater than or equal to the respective 70-year cancer benchmarks:

  1) Arsenic Compounds, 2) Chromium Compounds,
  3)Acetaldehyde,4) Benzene, and 5) Formaldehyde.

- Formaldehyde's annual average ambient concentration was also greater than its 30-year and 15-year cancer benchmarks.

CAP Phases I and II Results – Excess Cancer Risk

Analyte	Annual Average Ambient Concentration	Cancer Benchmarks Associated With Duration of Exposure		
		70-Year	30-Year	15-Year
Arsenic Compounds	0.002 ug/m^3	0.002 ug/m^3		
Risk in 100,000		1		
Chromium Compounds	0.002 ug/m^3	0.002 ug/m^3		
Risk in 100,000		1		
Acetaldehyde	2.668 ppbv	2.5 ppbv		
Risk in 100,000		1		
Benzene	0.444 ppbv	0.41 ppbv		
Risk in 100,000		1		
Formaldehyde	3.72 ppbv	0.627 ppbv	1.46 ppbv	2.93 ppbv
Risk in 100,000		5.9	2.5	1.3

µg/m^3 = micrograms per cubic meter
ppbv = parts per billion by volume

CAP Phases I and II Results – Additivity of Cancer Risk

Analyte	Weight-of-Evidence Classification	Cancer Risk Associated With 70-Year Exposure (1 in 100,000)
Arsenic Compounds	A	1.0
Benzene	A	1.0
Chromium Compounds	A	1.0
Total		3.0
Acetaldehyde	B2	1.0
Formaldehyde	B1	5.9
Total		6.9

CAP Phases I and II Results – Additivity of Cancer Risk

Summary

- The annual average ambient concentrations of
  - arsenic compounds,
  - chromium compounds,
  - acetaldehyde,
  - benzene, and
  - formaldehyde

  pose for the residents of St. Louis City a total excess cancer risk equal to 9.9 additional cases of cancer in a human population of 100,000 following 70 years of exposure.
- Formaldehyde is the primary driver of the cancer risk.

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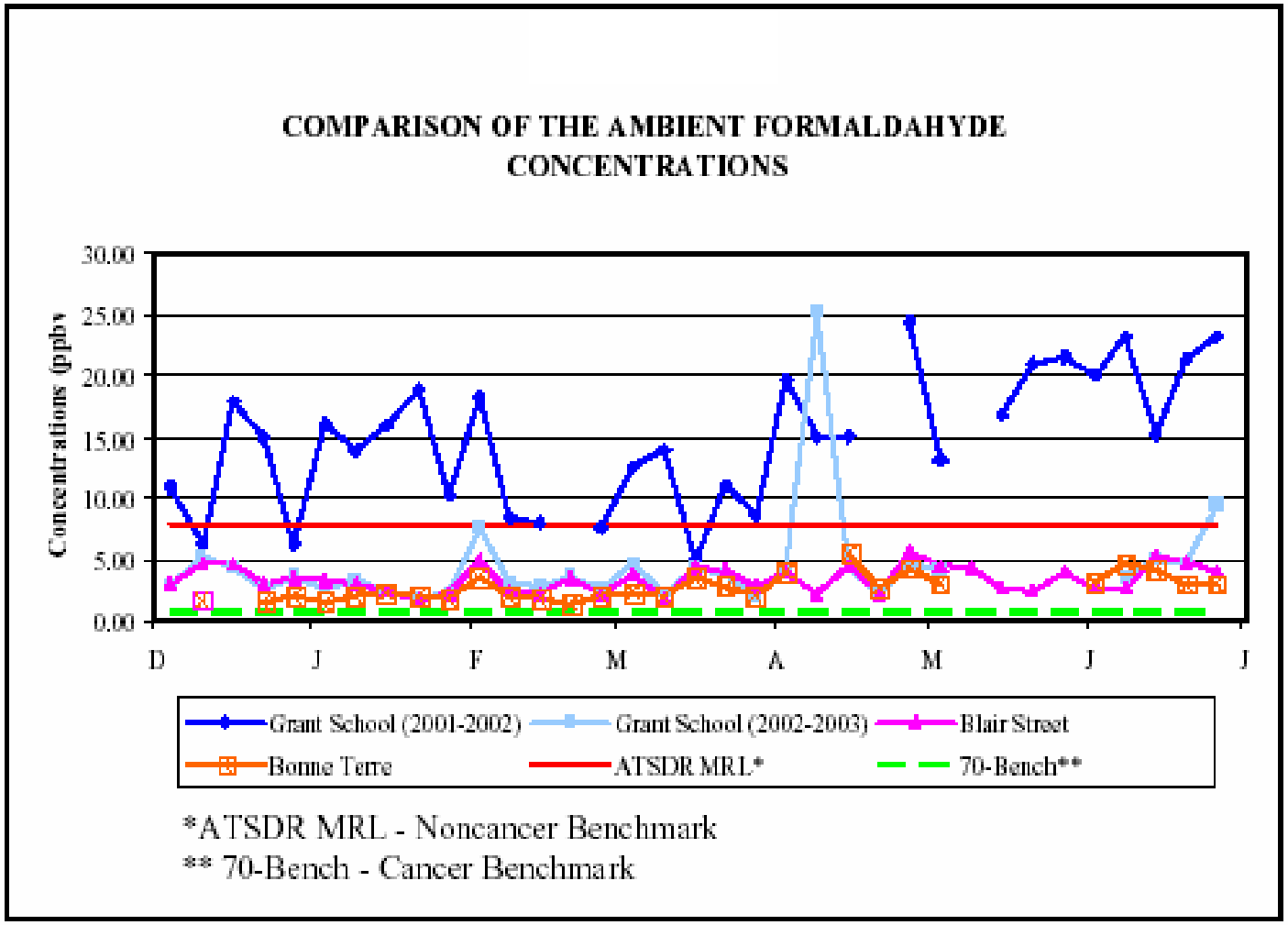
CAP Phase I versus Phase II



Observations

- Only five analytes measured had average annual ambient concentrations equal to or greater than the 70-year cancer benchmark.
- The ambient concentrations of these five analytes were comparable to the ambient concentrations of these five analytes measured in other urban areas as EPA's Urban Air Toxics Monitoring Program reported.
- Annual average ambient arsenic, chromium, and elemental carbon concentrations were comparable to annual average ambient concentrations of these analytes measured in other urban areas as part of EPA's $PM_{2.5}$ Speciation Network.

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CAP Phase II Site-By-Site Results

	Grant School	Blair Street	Arnold	Mingo	70-Year Bench
Time Period	**6/18/01 to 6/25/02**	**9/12/00 to 9/12/03**	**9/12/01 to 9/12/03**	**8/12/02 to 8/12/03**	
Analyte					
Arsenic Compounds	0.002 µg/m^3	0.0021 µg/m^3	0.0021 µg/m^3	0.00079 µg/m^3	0.002 µg/m^3
Chromium Compounds	0.002 µg/m^3	0.0023 µg/m^3	0.0019 µg/m^3	0.00040 µg/m^3	0.002 µg/m^3
	Grant School	**Blair Street**	**Bonne Terre**		
Time Period	**12/4/02 to 12/29/03**	**12/4/02 to 12/29/03**	**12/4/02 to 12/29/03**		
Analyte					
Acetaldehyde	2.55 ppbv	2.01 ppbv	2.11 ppbv		2.5 ppbv*
Benzene	0.438 ppbv	0.481 ppbv	0.19 ppbv		0.41 ppbv
Formaldehyde	3.72 ppbv	4.08 ppbv	3.4 ppbv		0.627 ppbv*

µg/m^3 = micrograms per cubic meter
ppbv = parts per billion by volume
*Under EPA's Scientific Advisory Board review.

Recommendations

- Monitoring and data analyses continue to support this effort. Development of an improved emission inventory will occur.
- Efforts to integrate the national particulate matter monitoring program into the national air toxics monitoring program should continue.
- Enhanced monitoring methods for hexavalent chromium compounds and total chromium compounds are needed to refine risk characterization.

Recommendations

- The available data and information led the St. Louis CAP Partnership to take actions to limit the impacts of these five analytes and diesel particulate matter. The action teams; Community Outreach, Education, and Diesel, will take actions to reduce ambient air pollution and improve public health.

Subsequent Ambient Air Studies

Comparison of Ambient Formaldehyde Monitoring Techniques and Site Data

- Using an EPA grant, MDNR obtained an OPSIS open-path ultraviolet differential optical absorption spectrometry (UV-DOAS) instrument.
- Under contract with MDNR, Dr. Jay Turner of Washington University in St. Louis (WUSTL) conducted initial deployment of the UV-DOAS instrument on the campus of WUSTL collecting ambient data every five minutes.
- Comparisons made between OPSIS UV-DOAS ambient data and 24-hour integrated ambient samples collected every sixth day on DNPH substrates at other locations in St. Louis City, Bonne Terre, MO, and Chicago, IL.

Subsequent Ambient Air Studies

Comparison of Ambient Formaldehyde Monitoring Techniques and Site Data

- UV-DOAS versus TO-11A comparisons showed good agreement between these ambient formaldehyde data, suggesting sites behaved similarly. For the May through June periods of 2003 and 2004, the maximum difference was smaller than 2.5 ppbv, and the median ratios (WUSTL/St. Louis-Blair Street) were 1.06 and 0.98, respectively.
- Compared to the formaldehyde mixing ratios of Bonne Terre, MO suggested that on an annual basis, the ambient formaldehyde concentration in St. Louis City was predominantly regional in nature.

Subsequent Ambient Air Studies

National Air Toxics Trends Sampling and Instrument Testing

- St. Louis City-Blair Street is now the location of a National Air Toxics Trends Station (NATTS). St. Louis City Air Pollution Control Division (APCD) operates an aethelometer and collects TO-15, TO-11A, PM_{10} metals ambient data for long-term trends analysis.
- Since June 2005, along with a few other NATTS, St. Louis City APCD has conducted initial deployment of a trace CO instrument at Blair Street.
- MDNR is operating the OPSIS UV-DOAS adjacent to the NATTS and field testing another continuous formaldehyde instrument. MDNR will compare data to TO-11A data to provide evidence for comparability of all three ambient sampling methods.

Future Ambient Air Studies

Ambient Particulate Arsenic and Other Air Toxic Metals

- MDNR applied for an EPA grant to conduct a community-scale monitoring study in the St. Louis area.
- The objectives of this study are to describe the climatology of ambient particulate arsenic and other selected air toxic metals in the area, and to develop a conceptual model, including identifying sources of ambient particulate arsenic and other selected air toxic metals.
- Under contract with MDNR, Dr. Jay Turner (WUSTL) and University of Maryland-College Park (UMCP) staff will conduct ambient sampling.

Future Ambient Air Studies

Ambient Particulate Arsenic and Other Air Toxic Metals

- The field study is proposed to proceed in two phases:
  - Phase I. Three PM_{10} air toxic metals sampling sites will collect ambient samples every third day for one year using inductively coupled plasma-mass spectrometry (ICP-MS) to analyze the samples. Phase I will refine the understanding of the spatial distribution of ambient particulate arsenic.
  - Phase II. A semi-continuous elements in aerosol (SEAS) sampler will collect ambient particulate matter at hourly time resolution at six sites and subsequent ICP-MS analysis. Phase II will provide refined information on the locations of emission sources of ambient particulate arsenic and other toxic metals.

St. Louis Community Air Project

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