AIR TOXICS MONITORING NEWSLETTER

A PUBLICATION OF THE STAPPA/ALAPCO–USEPA SAMWG AIR TOXICS MONITORING SUBCOMMITTEE

July 2004

The Air Toxics Monitoring Steering Committee was established in 1999 for the purpose of assisting USEPA in preparing recommendations for a national air toxics monitoring network. In 2003, the role and responsibility of the Steering Committee changed and it was re-constituted as the Air Toxics Monitoring Subcommittee of the Standing Air Monitoring Workgroup (SAMWG). Members include representatives from several states and local agencies (Vermont, New Jersey, Texas, Oregon, California, Puget Sound), multi-state organizations (LADCO), and USEPA (OAQPS and some Regional Offices). Recent activities related to the national network are discussed in this quarterly newsletter.

FY05 Grant Funds

On April 7, 2004, USEPA issued final guidance for the allocation of $10 million in FY2005 money to support national air toxics monitoring activities. The grant guidance identifies five major areas:

> $2.685 M for continuation of the 22-site national air toxics trends sites (NATTS)
>
> $0.57 M for instrument/method/operation and maintenance contingencies (i.e., support for special instrumentation initiated with FY04 funding, including continuous formaldehyde and high resolution carbon monoxide)
>
> $0.4 M for NATTS quality assurance
>
> $0.345 M for national data analysis contract and data analysis workshop
>
> $6.0M for local scale monitoring projects

Additional guidance will be provided in fall 2004 concerning the local scale monitoring projects.

Data Analysis Workshop

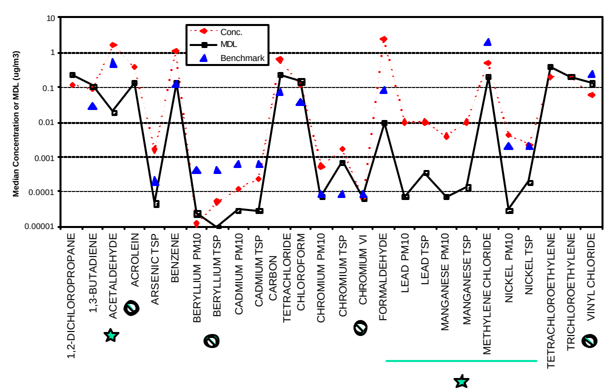
On June 2 – 3, a workshop was held to review the results of the latest air toxics data analyses. These analyses, which are being performed by Sonoma Technology, Inc., are intended to provide a comprehensive "look" at existing air toxics data; present a clear message to policy makers about air toxics concentrations across the country from both national-level and local community-level perspectives; and provide guidance and tools to enable state and local agencies collecting air toxics data to look at and use their own data.

The workshop presentations were organized to help answer several key questions, as summarized below. Additional articles are included in this newsletter on a variety of other topics covered during the workshop.

How good are the data?

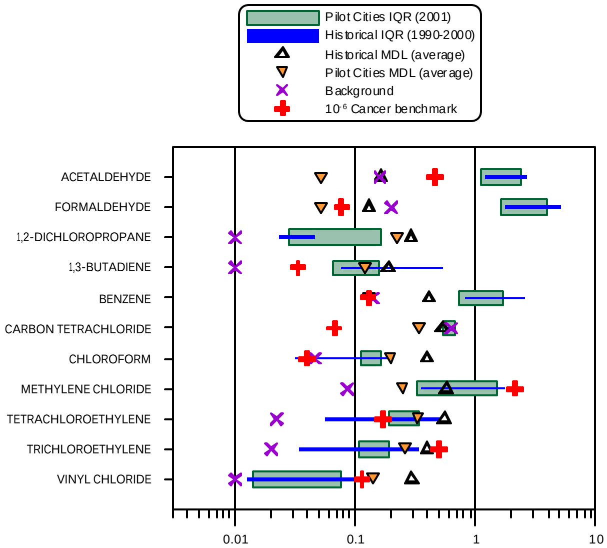
The current analyses focused on almost 800 sites with at least one validated annual average in the historical data base (1960s – 2000) and 37 sites in the pilot city data base (2001), and on 18 hazardous air pollutants (HAPs). Data validation included automated data "cleaning", retaining as much data as possible, creating defensible average values, and applying relevant flags. (Note, a value of ½ the minimum detection limit [MDL] was substituted for any missing data in deriving averages, but averages were flagged to indicate the % of samples below MDL) The final data base reflects considerable variation in the number of samples by species (i.e., most number for lead TSP, least for acrolein) and in the site locations (i.e., most of the sites are urban and many regions of the country are not well represented).

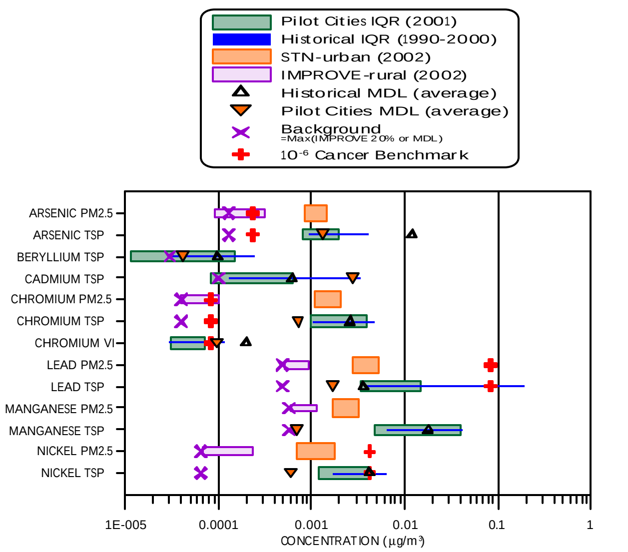
Confidence in the data varies by pollutant, with high confidence for some species, such as acetaldehyde, benzene, formaldehyde, lead, manganese, methylene chloride, and nickel (i.e., those with median concentrations well above MDLs, as seen below), and low confidence for others, such as acrolein, beryllium, chromium VI, and vinyl chloride (i.e., those with median concentrations close to MDLs).



Annual Average Air Toxics Levels: Mean Measured Concentrations and MDLs, (2001 Pilot City Data)

To put the measured concentrations in perspective, the interquartile (25th – 75th percentile) historical and pilot city data are presented below, along with the MDLs, background levels, and cancer benchmarks.





Air Toxics Levels: Range of Historical and Pilot City Data, MDLs, Background, and Cancer Benchmarks for VOCs and Carbonyls (top), and Metals (bottom)

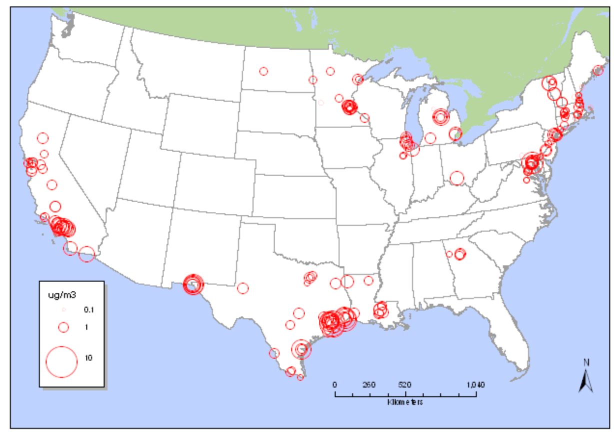
The measured data range exceeds the cancer benchmarks for acetaldehyde, formaldehyde, 1,3-butadiene, benzene, carbon tetrachloride, arsenic, and chromium (note: it is unclear if chromium VI concentrations are typically above the cancer benchmark due to high MDLs). All species are well below noncancer reference concentrations

The background values for VOCs are about an order of magnitude below the typical urban concentration range. Regional (rural) background values of metals are also much lower than urban concentrations.

Comparing the MDLs to cancer benchmarks shows that, for example, chromium measurement techniques need improvement in order to quantify cancer risk levels (i.e., the benchmark concentrations are at or below the current MDLs).

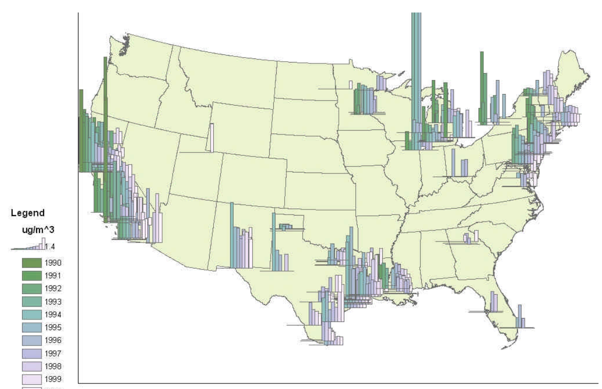
What are air toxics concentration levels nationally and locally?

Air toxics concentrations vary spatially. A number of case studies were performed to assess the spatial variability. As an example, benzene concentrations during 1999 show relatively little variation (factor of 2-3) across the U.S. – see figure below.



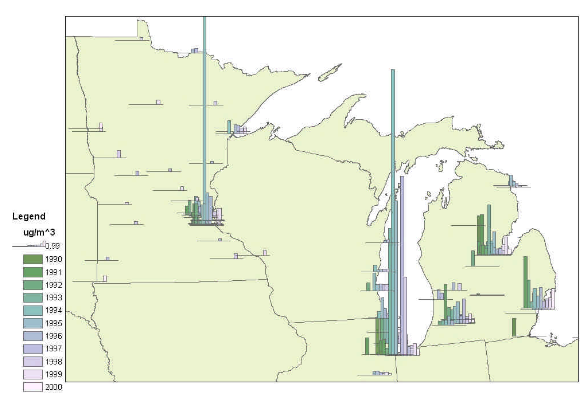
Summer Average Benzene Concentrations (1999)

Over the period 1990 – 2000 for benzene, the figure below shows a few "hot spots" spatially and temporally.



Annual Average Benzene Concentrations (1990-2000)

For example, high concentrations in northwest Indiana in the mid-1990s (see figure below) were found to be due to a nearby coke battery facility.



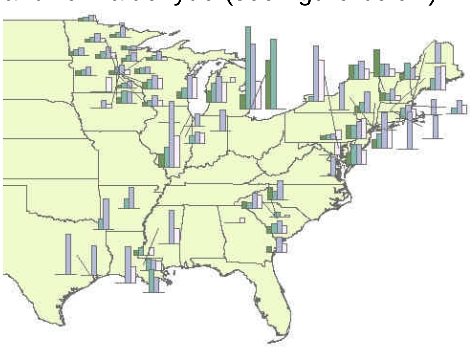
Annual Average Benzene Concentrations (1990-2000)

Examination of urban-scale concentrations showed that average concentrations of species with lifetimes greater than a few hours or dominated by area source emissions vary by less than a factor of three on the urban scale, whereas those with shorter lifetimes or dominated by local point sources can vary by a factor of 10 or more. Also, fingerprints for cities and regions reflect similarities due to similar emission sources (e.g., motor vehicles), and some differences due to industrialization and monitor placement.

To determine how many monitors are needed to capture citywide average air toxics concentrations, consideration should be given to the importance of point sources and species residence times. To capture exposures near roadways, other studies have shown a significant spatial gradient suggesting the need for several monitors located at varying distances.

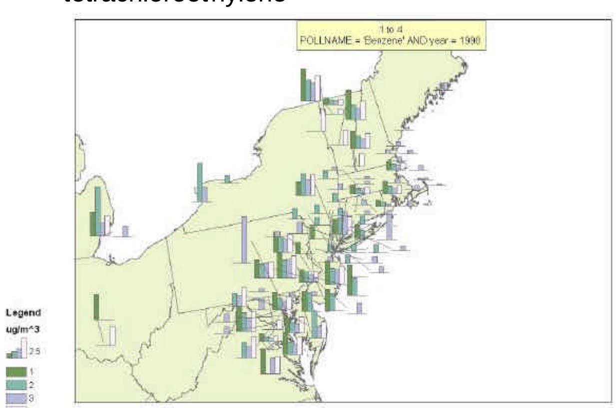
Air toxics concentrations vary seasonally:

Summer/High and Winter/Low: acetaldehyde and formaldehyde (see figure below)



Seasonal Average Formaldehyde Concentrations(1988)

Winter/High and Summer/Low: 1,3-butadiene, benzene (see figure below), and tetrachloroethylene

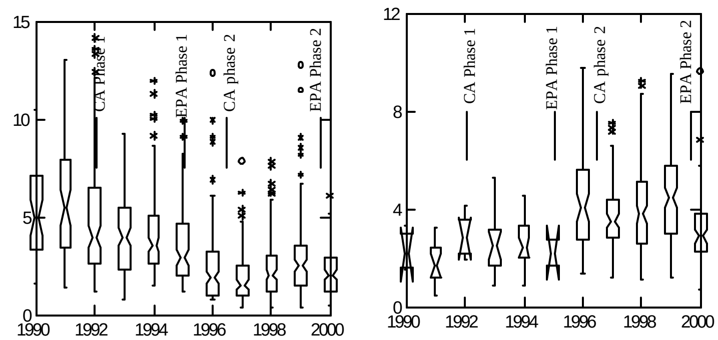


Seasonal Average Benzene Concentrations (1998)

Inconsistent (or No) Seasonal Trend: Lead and carbon tetrachloride

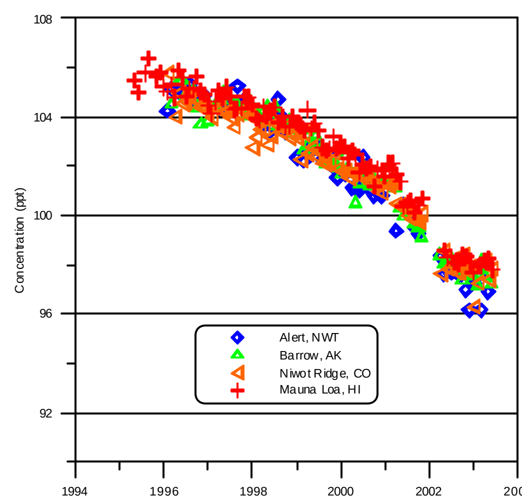
What do air toxics data say about the effectiveness of control programs?

Air quality improvements due to emission reductions have been measured. For example, benzene and 1,3-butadiene concentrations have declined in response to the use of reformulated gasoline, but formaldehyde concentrations have increased (see figure below, where the boxes indicate the 25th to 75th percentile concentration range and the middle notches indicate the 95% confidence interval around the median).



Seasonal Average Benzene (left) and Formaldehyde (right) Concentrations for all Sites in California

Other examples of decreasing trends include carbon tetrachloride (due to a phase-out in production by 1995, per Title VI of the Clean Air Act) and chloroform (due to MACT standards in mid-1990s).



Trends in Carbon Tetrachloride Concentrations (Montzka, et al, Nature, 1999)

Source Apportionment Analyses

An initial statistical analysis was performed by STI for several pilot cities (Seattle, Detroit, and Tampa) and other cities (San Jose, Phoenix, Minneapolis, and Wagner, MN) to identify source contributions to air toxics concentrations. A summary of the results are presented in the table below.

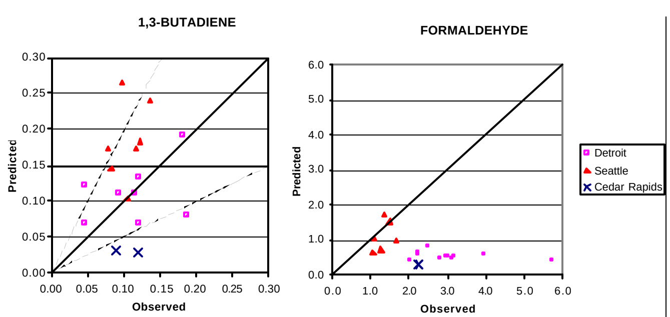
Source Types	% of Variance San Jose	Seattle	Minneapolis	Wagner	Detroit (Allen Park)	Tampa Bay	Phoenix (3-hr)
Mobile	25	22	21	11	23	10	23
Secondary/ Regional		7	16	47*	11	27	27
Misc. Industrial	21*	13	7		24*	7	
Smelter or Incinerator					14	5	
Combustion					7	12*	
Soil/Road dust	19	9			8	4	
Solvent/Dry clean	5		21*	11		7	16
Paint?	5		7	10			
Metal plating	8					4	
Sea Salt		9				6	
Unknown		16*		8			
Global Background				6			

As can be seen, some source types are common across these cities, including mobile sources, secondary/regional transport, solvent use, soil/road dust, combustion, and sea salt at coastal sites. To provide more definitive information on source contributions, a combination of other information (e.g., trajectories) and more quantitative apportionment methods should be considered.

Urban Air Toxics Modeling

A limited evaluation of urban-scale modeling techniques (ISCST3) was conducted using pilot city data from Detroit, Seattle, and Cedar Rapids. Model inputs were prepared using NWS meteorology and EPA's 1999 National Toxics Inventory.

Comparisons of annual average modeled and monitored concentrations showed reasonable agreement for most VOCs, and generally poor agreement for carbonyls and metals (see figures below). The figures also show a tendency for underprediction for all species in Cedar Rapids.



Scatterplots of Modeled v. Measured Concentrations for 1,3-Butadiene (Left) and Formaldehyde (right)

STI recommended that before the models are ready for use as planning tools, efforts should be made to improve air toxics emissions inventories, better integrate physics and chemistry at difference spatial scales, and improve meteorological inputs.

Next Steps

STI will provide a number of work products later this summer, including:

- Papers: "Lessons Learned from Phases I and II Air Toxics Data Analyses" (currently available on LADCO web site: http://www.ladco.org/toxics/reports/PolicyRelevance_WhitePaper.pdf); journal article on background concentrations; and "Lessons Learned from Phase III Air Toxics Data Analysis"
- Data: electronic database with validated historical and pilot city data; CD and web site compilation of maps; and documentation of database cleaning
- Data Validation: summary sheets for 18 HAPs, plus acrolein and elemental carbon
- Data Analysis: workshop presentations (currently available of LADCO web site); and technical memoranda on case studies, source apportionment analyses, and ISC modeling
- Tools: bar chart mapper for ArcGIS; and VOCDat (Note: updated AMDAS and USEPA's air toxics data website will be provided pursuant to other work efforts)

Much of this information will be compiled together in a workbook format and posted on the LADCO website. A CD and, upon request, paper copies of the "workbook" will be provided. LADCO expects to receive draft products in early August and final products by the end of August.

The coordination of nationwide efforts for analyzing air toxics monitoring data will shift to USEPA in FY05 and will be led by Joe Touma. The new work will focus on assessing the national ambient monitoring levels, characterizing trends for air toxic pollutants, explaining reasons for these levels and trends, and describing the degree of program effectiveness. This work will build on existing analyses lead by LADCO and use all available national air toxics data in Air Quality System (AQS), and add data housed in the Interagency Monitoring of Protected Visual Environments (IMPROVE) data base as it relates to HAPs. Although ERG will be the main contractor, the services of previous contractors will be utilized.

The recently completed Sonoma Technology, Inc. work covered the period of AQS data through 2001. Thus, USEPA will be pulling 2002 and 2003 data from AQS. For a complete representation of air toxics concentrations measured in the country, we will need your help in ensuring that all toxics monitoring data collected in your Region and State are entered into AQS. Please contact Joe Touma at 919-541-5381 for information on this effort.

For information on national air toxics monitoring, please contact Sharon Nizich, USEPA, OAQPS, nizich.sharon@epa.gov , 919-541-2825. For information on the data analysis projects, please contact Michael Koerber, LADCO, koerber@ladco.org, 847-296-2181. This newsletter is issued on a regular (quarterly) basis to provide status reports on air toxics monitoring activities.