

# PAMS DATA USAGE REPORT

(Cross-Tabulation of PAMS Data in  
Studies/Analyses 1999-2000)



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November 30, 2000

**PAMS Data Usage Report**  
**(A Cross-tabulation of PAMS Data in Studies/Analyses 1999-2000)**

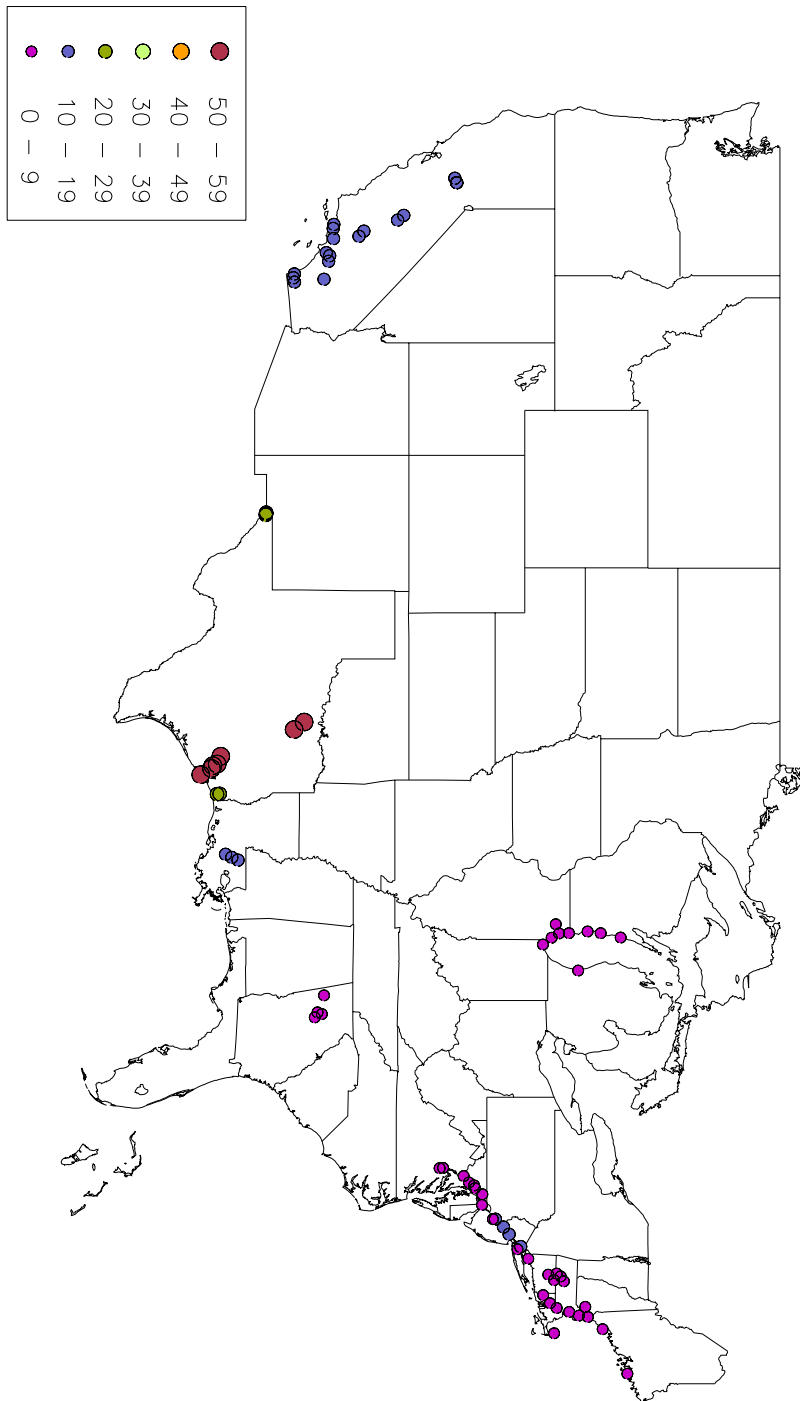
This report provides an overview on PAMS (Photochemical Assessment Monitoring Stations) data used in known studies and analyses done in the 1999-2000 timeframe. Through an analysis of these studies/analyses this report provides feedback on the PAMS network by quantifying 1) the extent PAMS data was used; and 2) the types of analysis being conducted with PAMS data.

The information used in this report is from a compilation of recent studies/analyses (1999 - 2000) that used data from the PAMS network. This information was compiled from informal requests to state/local agencies, EPA Regional offices, a search of relevant websites, and a literature search of scientific journals. A total of 41 studies and analyses were compiled for this analysis. Appendix A contains a summary of the studies and analyses evaluated for this report. The summary includes an abstract, a brief description of the geographic area covered, PAMS data used, and a point of contact. Of the studies/analyses compiled the majority were done by state and local agencies. Studies/analyses that used PAMS data were also done by US EPA offices, regional air management/planning organizations, and an industry trade organization. In addition one major journal article, published in Atmospheric Environment (Cardelino and Chameides, 2000), was found that used PAMS data.

First, the 41 studies/analyses were evaluated by tabulating which PAMS sites and years of PAMS data were used. For example, if a study used PAMS data from the Yorkville PAMS site (Atlanta, GA) for the years 1994 through 1998, the site would be credited for each year used, even if only a subset of all yearly data was used. Appendix B, Tables A-G, summarizes this information by EPA Region. Tabulation of this data shows that data from each PAMS site was used along with PAMS data from the years 1994-1999. Of all the PAMS sites, the Texas sites were used most frequently in the studies/analyses evaluated (see Figure 1-PAMS Data Frequency of Use).

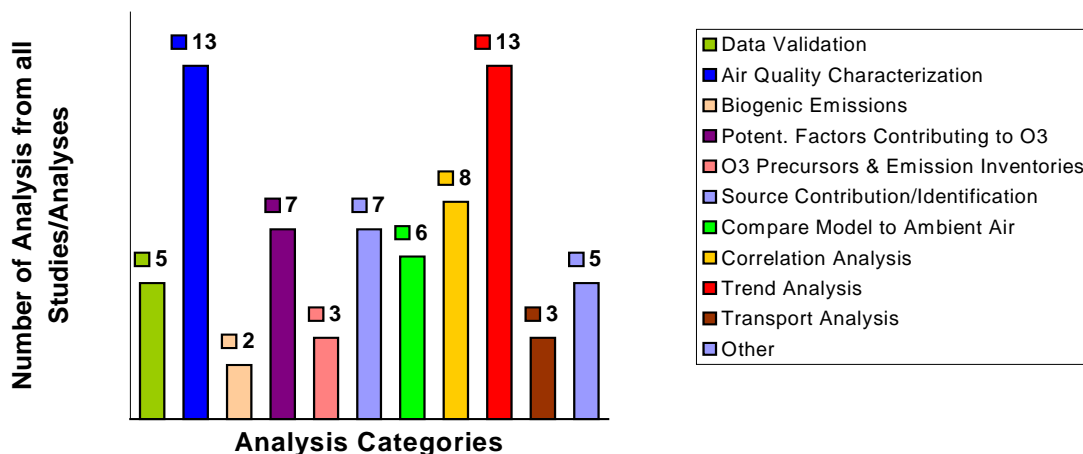
The PAMS network was designed around six objectives focused on the collection of specific meteorological and ambient data for future types of analysis that would help air quality managers/regulators make informed decision on the overall control of VOC and NO<sub>x</sub> and reduction of ozone. In order to help achieve the PAMS objectives EPA developed the PAMS analysis workbook in 1995. This workbook, which was recently revised in September 2000, provides various analysis techniques that state/local agencies along with EPA Regional offices can perform to help put the PAMS data into a meaningful context to help inform the air quality management/regulatory decision-making process. The analysis techniques in the PAMS workbook are grouped into one or more categories that are related to the assessment/evaluation of specific issues related to VOC, NO<sub>x</sub> and ozone control programs. Table 1 contains the six PAMS network objective along with the list of the PAMS workbook assessment categories and supporting analysis techniques.

FIGURE 1 – PAMS DATA FREQUENCY OF USE  
(total number of times data from a PAMS site (site/year)  
was used in a known study/analysis 1999–2000)



The studies and analysis compiled for 1999-2000 were reviewed for the types of analysis performed. These analyses were then assigned to one or more of the PAMS workbook analysis categories (see Appendix A for assigned analysis categories). The evaluation of the 41 studies and analyses compiled shows that one or more analysis was conducted for all of the analysis categories contained in the PAMS workbook. Six of the eleven analysis categories, Air Quality Characterization, Potential Factors Contributing to Ozone, Source Contribution/Identification, Compare Model to Ambient Air, Correlation Analysis, and Trend Analysis, account for seventy-five (75) percent of the total number of analyses.

**Figure 2 - Distribution of Analysis Categories**  
(Study/Analysis may contain more than 1 category)



In a recent critical review of national monitoring networks in North America (Demerjian, 2000) states that as the richness of air quality data sets develops, data analyses opportunities to address user needs will improve. Demerjian presents a summary of user needs (air quality management/regulatory and science) in the form of policy and scientific questions along with a list of supporting analysis techniques and data requirements from PAMS network that would facilitate answers to the questions posed. The second evaluation in this report on the type of supporting analysis conducted in recent studies/analyses shows that the PAMS network is now starting to provide a rich data set for analysis. It also provides strong qualitative evidence that data from the PAMS network is being used to provide answers to air quality management/regulatory and science questions as envisioned by EPA.

In conclusions, the limited analysis done for this report shows that PAMS data are being used. The evaluation of the analysis techniques with respect to the PAMS workbook analysis categories also indicates that PAMS data are being used as the PAMS objectives intended.

**TABLE 1 – PAMS NETWORK OBJECTIVES, PAMS Workbook Analysis Categories/Supporting Analysis Techniques**

<p align="center"><b>PAMS Network Objectives</b></p>	<p align="center"><b>PAMS Workbook Analysis Categories <i>Supporting Analysis Techniques</i></b></p>
<ul style="list-style-type: none"> <li>• Provide a speciated ambient air database which is both representative and useful for ascertaining ambient profiles and distinguishing among various individual VOC. These data can later be used as evaluation tools for control strategies, cost-effectiveness, and for understanding the mechanisms of pollutant transport.</li>   <li>• Provide local, current meteorological and ambient data to serve as initial and boundary condition information for photochemical grid models. These data can later be used as a baseline for model evaluation and to minimize model adjustments and reliance on default settings.</li>   <li>• Provide a representative, speciated ambient air database which is characteristic of source emission impacts. These data can be particularly useful in analyzing emissions inventory issues and corroborating progress toward attainment.</li>   <li>• Provide ambient data measurements which would allow later preparation of unadjusted and adjusted pollutant trends reports.</li>   <li>• Provide additional measurements of selected criteria pollutants. Such measurements can later be used for attainment/nonattainment decisions and to construct NAAQS maintenance plans.</li>   <li>• Provide additional measurements of selected criteria and non-criteria pollutants from properly-sited locations. Such measurements can later be used for evaluating population exposure to air toxics as well as criteria pollutants.</li> </ul>	<ul style="list-style-type: none"> <li>• PAMS Data Validation <i>Scatter, box-whisker, time, series, and fingerprint plots, internal consistency using ratios</i></li>   <li>• Assessment of (Air Quality) Spatial and Temporal Characteristics <i>Summary statistics, most abundant, comparing composition among sites, assessing relationships among species, ozone episode vs. non-episode days</i></li>   <li>• Assessment of Biogenic Emissions <i>Abundant species, diurnal profiles, relationships between biogenics and other measurements (temperature, radiation)</i></li>   <li>• Assessment of Potentially Important Factors Contributing to Ozone <i>Relative age of hydrocarbon mixtures, biogenic contributions to ambient NMHC</i></li>   <li>• Evaluation of Ozone Precursors and Emission Inventories &amp; Receptor Modeling <i>Comparison to emission inventories and emissions processing software through ratios</i></li>   <li>• Assessment Source Contribution/Identification <i>Spatial and temporal chrematistics, multivariate analyses (cluster factor/principal component, regression)</i></li>   <li>• Comparison of Photochemical Model Results with Ambient Air Quality <i>Surface air quality using times series analysis, contour plots, scatter plots, assessment at regional boundaries</i></li>   <li>• Correlation Analysis (NO<sub>x</sub>, NO<sub>y</sub>, Ozone) <i>VOC/NO<sub>x</sub> limitations through indicator ratios, use with observational based models</i></li>   <li>• Trend Analysis (Emissions and Ambient) <i>Time series, mean and extreme values, adjustment for meteorological variables (Cox and Chu, Rao and Zurbenko, etc.)</i></li>   <li>• Transport Analysis <i>Tracers for upwind emission source, comparison to grid modeling results</i></li> </ul>

**APPENDIX A**  
**SUMMARY OF STUDIES/ANALYSES IN 1999-2000 USING PAMS DATA**

The following are abstracts of the studies/analysis that were evaluated for this report:

**Exploring Potential Ozone Precursor relationships using PAMS Data. U.S. EPA, OAQPS/EMAD**

*Abstract: Analysis* - Generalized regression analysis was used to explore the relationship between daily maximum 8-hour ozone, meteorology and PAMS precursors. Precursor variables included 6-9 am average for olefins, aromatics and paraffins and NO<sub>2</sub>. *Results* - A set of regression response curves were produced for each urban area and species. The response curve, along with its standard error indicates the degree to which that species is associated with ozone after accounting for meteorological effects. Generally, daily maximum ozone increased with increasing levels of morning NO<sub>2</sub> and paraffins and decreased with increasing levels of morning olefins and aromatics. However, significant differences were observed among urban areas, most notably for Houston, Atlanta and Dallas for which the NO<sub>2</sub> response was very strong.

**Geographic Area Covered:** Data from PAMS sites near Boston, Hartford, New York, Philadelphia, Baltimore, Washington, Atlanta, Houston, Dallas and Chicago

**Data Used:** Hourly PAMS VOC and NO<sub>x</sub> data coupled with hourly ozone data from the urban network. Hourly meteorological data from the nearest National Weather Service station.

**Contact:** Bill Cox, U.S. EPA, Office of Air Quality Planning and Standard, EMAD (MD-14), RTP, NC 27711  
phone: (919) 541-5563; e-mail: [cox.bill@epa.gov](mailto:cox.bill@epa.gov)

**Analysis Category:** air quality characterization, ozone precursors and emission inventories

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**PAMS Data Analysis, NJDEP**

*Abstract: Analysis* - Selected 10 species from each site for analysis based on concentration x MIR. Characterized data from each site independently in terms of average concentrations, predominant species, time of day variations, day of week variations. *Results* - Report pending.

**Geographic Area Covered:** Rider (Lawrenceville, Type 3 site for Philadelphia area) and Rutgers (New Brunswick, Type 1 site for New York area) sites

**Data Used:** Rider 1995-97 and Rutgers 1996-97

**Contact:** Rudy Zsolway, NJDEP (New Jersey Department of Environmental Protection)  
phone: (609) 292-0138; e-mail: [rzsolway@dep.state.nj.us](mailto:rzsolway@dep.state.nj.us)

**Analysis Category:** air quality characterization

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**1998 Ozone Report (PAMS VOCs Influence on Ozone Levels Northern New Jersey) NJDEP**

*Abstract: Analysis* - The following summary is for the PAMS Data Review portion of the 1998 Ozone Report. The VOCs data allows NJDEP and other air monitoring agencies to look at what compounds were present during the major ozone episodes. Since all of the 1998 PAMS data had not yet been compiled, a three-site comparison was done using 1997's data. Camden is a Type 2A site and measures the highest overall VOC concentrations of the three sites. Rutgers and Rider Universities' sites, Types 1 and 3, respectively, are more heavily influenced by biogenic emissions such as isoprene. Isoprene is highly photochemically reactive and is influential in the formation of ground level ozone. Rutgers University has unusually high toluene concentrations, another influential ozone precursor, which is probably the result of a major point source upwind of the site. Further PAMS evaluation will be done when the annual summary reports become available. The report includes VOC data graphs for target VOC species concentrations on certain 1998 ozone episode dates at the three sites, and average species concentrations in the 1997 ozone season for three sites shown on the same graph.

*Results* - The conclusion for the PAMS data analysis is as follows: Preliminary reviews of this data have shown no distinct differences from regular, non-exceedance, sample days.

The complete results are listed in 1998 Ozone Report, which is available from the following Internet site:

<http://www.state.nj.us/dep/airmon/98o3rpt.htm#abstract>.

The overall report concludes the following: New Jersey's air quality has improved over time; Extremely high 1-hour average concentrations, like those seen a decade ago, occur less and less frequently now; However, 8-hour average concentrations seem to have leveled off since 1994; Unlike past years, some of the worst episodes in 1998 occurred when temperatures never rose above 90 degrees.

**Geographic Area Covered:**

**Data Used:** 1998 PAMS data from Rutgers (New Brunswick, NJ, Type 1), Camden (Type 2A), Rider (Lawrenceville, NJ, Type 3) sites in New Jersey

**Contact:** Jim Oxley, NJ Department of Environmental Protection;  
phone: (609) 633-1468; e-mail: [joxley@dep.state.nj.us](mailto:joxley@dep.state.nj.us)

**Analysis Category:** air quality characterization

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### **Wind Rose Analysis NJDEP**

Abstract: **Analysis** - This was an informal exploration of a relationship between toluene concentrations and wind speed and direction at the Rutgers site. **Results** - A correlation between concentrations and a specific direction and, ostensibly, source was not realized.

Geographic Area Covered: Rutgers PAMS site (New Brunswick, NJ)

Data Used: 1998 toluene concentrations and meteorological data from the Rutgers site (Type 1)

Data Analysis Contact: Jim Oxley, NJ Department of Environmental Protection;

phone: (609) 633-1468; e-mail: [joxley@dep.state.nj.us](mailto:joxley@dep.state.nj.us)

**Analysis Category:** source contribution/identification

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### **An Assessment of the 6 to 9 a.m. Measurements of NMOCs in New York City NYSDEC**

*Abstract:* **Analysis** - For the two subject years and sites, PAMS data were obtained from AIRS and Eisenhower Park, a NAMS/SLAMS site, data were obtained from Eastern Research Group, Durham, NC, an EPA contractor. Of 218 canister samples from Eisenhower Park, 94 are on dates for which there are hourly data at the Bronx PAMS site. Average values for the 6-9 a.m. NMOC data at the PAMS site were compared with the 6-9 a.m. aggregate NMOC concentrations for the canister samples at Eisenhower Park. Scatter plots were examined. **Results** - Average NMOC concentrations for the two sites are different. This indicates the influence of localized emissions and lack of a regional component. During the 6-9 a.m. period, the low-level inversion is slowly rising and mixing with the upper layers, and there is no significant advection component. This is a preliminary result. Note the following which may influence this conclusion: (1) There were more measurements in 1995 than in 1996 at the PAMS site. (2) PAMS NMOC may or may not include all of the compounds represented in the canister NMOC analysis; e.g., AIRS parameter code 43102 does not include aldehydes and higher-carbon-number compounds. DEC plans to expand the study to include data through 1999, Newark, NJ, canister data, and New Brunswick PAMS (Rutgers, Type 1 site) data. Results will be published in a paper in the future after further work is completed.

**Geographic Area Covered:** New York City metropolitan area

**Data Used:** 1995 and 1996 PAMS hourly NMOC data from the Bronx Botanical Gardens PAMS site (Type 2) and canister NMOC data from Eisenhower Park, NY (NAMS/SLAMS site), for 6-9 a.m.

**Contact:** Gopal Sistla, NYSDEC (New York State Department of Environmental Conservation)

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**Analysis Category:** air quality characterization, transport analysis

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### **Exploratory analysis of PAMS data from the Bronx, NY NYSDEC**

*Abstract:* **Analysis** - Measured PAMS ozone precursor concentrations were aggregated into CBIV classes of chemical species. The concentrations were compared to UAMV ozone model predicted hourly volume-average concentrations of the CBIV classes in the 12 km x 12 km x 50 m high grid cell volume containing the Bronx PAMS site. **Results** - The majority of the CBIV species were found to be underpredicted, although the diurnal cycle was captured. There is a need for further detailed assessment of the emissions data put into the UAMV model relative to PAMS data during the early morning hours. Results will be published in a paper in the future after further work is completed.

**Geographic Area Covered:** New York City metropolitan area

**Data Used:** July 10-19, 1995, ozone episode precursors data from the Bronx Botanical Gardens PAMS data (Type 2 site) and UAMV ozone model predictions

**Contact:** Gopal Sistla NYSDEC (New York State Department of Environmental Conservation)

phone: (518) 457-3200; e-mail: [gsistla@air.dec.state.ny.us](mailto:gsistla@air.dec.state.ny.us)

**Analysis Category:** compare model to ambient air

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### **US EPA Region 2 Phase 2 Strategic Plan, Draft Environmental Threats Analysis, Clean Air, Air Toxics US EPA Region II**

*Abstract:* **Analysis** - The results of EPA's Cumulative Exposure Analysis (CEP), which did not include Puerto Rico and the Virgin Islands, parts of Region 2, were used to characterize risk in Region 2 from the 33 hazardous air pollutants (HAPs, air toxics) called urban air toxics. While New York has years of toxics monitoring data at many sites, it was not in a form easily accessible or usable for the analysis done. The PAMS data in AIRS and AMDAS files were easily-accessible and easily usable. Of the pollutants identified as of greatest concern based on the CEP, benzene and formaldehyde were the only PAMS target compounds. EPA Region 2's GIS was used to count census tracts that exceeded certain multiples of the benchmark human health concentrations per the CEP results and a screening-type risk analysis was done. **Results** - The urban air toxics of greatest concern were POM (polycyclic organic matter) for cancer risk and acrolein for noncancer risk.

In New York, New Jersey, and New York City, the screening risk was  $\geq 1/100,000$  for  $\geq 50\%$  of the census tracts for benzene, chromium, formaldehyde, POM, and carbon tetrachloride; in addition for New Jersey and New York City is 1,3-butadiene. The screening risk was  $\geq 1/10,000$  for POM in 49%, 35%, and 100%, respectively, of the census tracts in New York, New Jersey, and New York City. The Bronx PAMS concentrations for benzene were  $> 1/100,000$  cancer risk, corroborating the concern based on the CEP estimate for 1990. Without an analysis using statistical approaches appropriate for skewed distributions, the standard deviations in the PAMS benzene data did not allow us to say that the decreases in average and median concentrations from the 1995 to the 1997 ozone season or for July 1994 compared to July 1995 are statistically significant.

**Geographic Area Covered:** New York, New Jersey, New York City

**Data Used:** Benzene from the Bronx Botanical Gardens PAMS site for 1994\* through 1997

\*1994 data set is not in AIRS.

**Contact:** Carol Bellizzi, US EPA Region 2, NY, NY

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**Analysis Category:** other

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#### **PAMS Data Validation Review For Georgia (Draft) US EPA Region IV**

**Abstract: Analysis** - In depth analysis of available speciated VOC data to determine the reliability of database for use in subsequent analyses. Analyses were performed using the VOCdat program (time-series analyses, extreme value identification, fingerprint plots) to identify potential outliers, calibration data carryover or other suspect data which might adversely affect data analyses. Review concentrated on 11 most abundant species in the Atlanta area, with more limited review of less abundant species. **Results** - Data recovery was relatively low for some site-years. For the data which was entered, the quality was generally good, and appeared to improve with each year. A limited number of extremely high values were identified which appeared to be erroneous. Several instances of apparent carryover of calibration data were also identified, along with individual data points which appeared to be inconsistent with surrounding data.

The suspect data list is being reviewed by the State of Georgia. The State has indicated they will be agree that some of the suspect data is, in fact, invalid and will be flagging that data in AIRS. Other of the suspect data will require further review before a decision is made on flagging.

**Geographic Area Covered:** Atlanta, Georgia

**Data Used:** PAMS data available in AIRS for 1995-97 at Conyers (Type 2) and South DeKalb (Type 1) sites and for 1996 at Yorkville (Type 3) site.

**Contact:** Tom Lyttle, US EPA Region 4, Air Planning Branch

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**Analysis Category:** data validation

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#### **Receptor Modeling/NOx and VOC Control Curve US EPA Region V**

**Abstract: Analysis** - To support the 1-hour attainment demonstration for the Lake Michigan states, the Region ran a receptor model for the 1995 PAMS data. The receptor model results were then used as input to an observation-based ozone model (based on the Carbon-Bond IV Model), which predicts ozone maxima from the receptor model coefficients, unallocated VOC mass, and other measured parameters (criteria gases, meteorological variables). Because the ozone model is computationally efficient (compared to grid-based models), it was used to generate O3 control curves for NOx and VOC by systematically varying the inputs from the original observations. **Results** - These control curves indicate, for real-world conditions, the status of the Lake Michigan area in terms of being NOx or VOC limited. By characterizing the summer's conditions this way, we can assess what types of control programs would be most effective in reaching attainment of the NAAQS. There are also plans to enhance the observation-based model so that PAMS data can be used directly instead of having to go through the receptor-modeling stage. This will be useful for determining relatively quickly whether an ambient mix is VOC or NOx limited.

**Geographic Area Covered:** Lake Michigan PAMS Area

**Data Used:** Lake Michigan PAMS

**Contacts:** Joe Chung, US EPA, Region V, Chicago, IL

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**Analysis Category:** air quality characterization, correlation analysis

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### **LADCO 1998 Data Analysis Report**

*Abstract:* **Analysis** - LADCO submits an annual report for each ozone season that analyzes the ozone and precursor data collected over the PAMS season. The most current (April '99) report summarizes the 1998 season and includes plots of ozone and precursor concentrations for the PAMS sites, diurnal profiles for weekdays/weekends, ozone pollution roses, and fingerprints of average PAMS species concentrations. It also presents results of supplemental measurements of NO<sub>y</sub> and ozone on flights over Lake Michigan, compares these aloft measurements with ground based sites, and describes the multi-day ozone episodes experienced over the summer. **Results** - The report makes some conclusions about the nature of ozone formation and the strong influence of meteorology, characterizes the typical conditions in the region, and notes the evidence of significant transport in the area.

**Geographic Area Covered:** Lake Michigan PAMS area

**Data Used:** PAMS, plus NAMS/SLAMS/SPMS

**Contact:** Mike Koerber, LADCO (Lake Michigan Air Directors Consortium);  
phone: (847) 296-2181; [ladco@interaccess.com](mailto:ladco@interaccess.com)

**Analysis Category:** data validation, air quality characterization, potential factors contributing to ozone, source contribution/identification, transport analysis

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### **Analysis of Ozone and Ozone Precursor Data in the Lake Michigan Area (AWMA paper)**

*Abstract:* **Analysis** - This paper summarizes the progress toward attainment made in the area by showing several metrics for ozone trend detection. It also presents results of three observation-based methods for determining the relative effectiveness of VOC versus NO<sub>x</sub> control—MAPPER, the receptor model/control curve method described above, and *Sillman's* indicator species ratio. **Results** - Reduction in local ozone levels can be attributed to local VOC control programs, as evidenced by the decline in ambient VOC and the VOC limited conditions in the severe nonattainment area. To reduce regional ozone, regional NO<sub>x</sub> controls will be effective in the Lake Michigan area, so we need to pursue both additional local VOC controls and regional NO<sub>x</sub> controls to reach NAAQS attainment.

**Geographic Area Covered:** Lake Michigan

**Data Used:** Ozone and PAMS

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**Analysis Category:** correlation analysis, trend analysis

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### **Effect of Reformulated Gasoline on Ambient CO Concentrations (AWMA paper)**

*Abstract:* **Analysis** - Analyzed ambient CO data from 93-98 to look for drop in CO when reformulated gas was introduced in 1995. Milwaukee sites were subject to reformulated gas; a control site in Madison Wisconsin was used for comparison as well. **Results** - A significant difference was found pre- and post-reformulated gas, showing that ambient CO was reduced by up to 0.9 ppm after reformulated gas

**Geographic Area Covered:** Milwaukee

**Data Used:** CO, but results impact PAMS and analysis will be expanded to PAMS data

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phone: (847) 296-2182; e-mail: [kenski@ladco.org](mailto:kenski@ladco.org)

**Analysis Category:** other

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### **Use of Time Series Methods to Detect Ozone Trends US EPA Region V**

*Abstract:* **Analysis** - Meteorologically adjusted trends were examined using an ARIMA procedure, controlling for the effects of temperature, wind speed, wind direction, and time. **Results** - Trends vary depending on the time period modeled. Over longer time periods, trends are generally significant and negative. Over shorter more recent time periods, trends are not as clear, with some not significant and some increasing. The largest decreases are seen near the shore of Lake Michigan in the urban source region, with smaller decreases or even increases seen further downwind. Regional background ozone has not decreased.

**Geographic Area Covered:** Lake Michigan region

**Data Used:** ozone and met data

**Contact:** Mike Rizzo, US EPA, Region V, Chicago, IL  
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**Analysis Category:** trend analysis

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**Analysis of Ozone and Ozone Precursor Trends from the Photochemical Assessment Monitoring Stations (PAMS) in the South Central U.S., U.S. EPA Region VI**

*Abstract:* **Analysis** - Ozone and Ozone precursor trends in four PAMS areas of the South Central U.S. which is important in assessing the effectiveness of ozone pollution control strategies in those areas. The analysis concentrates on the period 1983-1999 and showcases patterns in 1-hour and 8-hour ozone standard design values, and patterns in June-August weekday morning arithmetic means for TNMOC and NOx. **Results** - 1-hour ozone design values have noticeably decreased in El Paso and Baton Rouge, have stayed generally level in Dallas-Fort Worth, and have recently climbed higher in the Houston area. Long-term VOC emission reductions are supported by ambient TNMOC data in Dallas-Fort Worth and Baton Rouge, and 1999 ambient weekday morning TNMOC concentrations in El Paso and Houston were lower than previous years' TNMOC measured concentration means. Ambient NOx concentrations have bounced up and down in all four areas from 1983-1999, but recent significant NOx concentration decreases have occurred in El Paso and Baton Rouge.

**Geographic Area Covered:** Baton Rouge, Louisiana, and Houston, Dallas-Fort Worth, and El Paso, Texas

**Data Used:** All historical TNMOC, NOx, and Ozone data from 1983-1999; also certain historical meteorological data (i.e. resultant wind speed, resultant wind direction, and temperature) back to 1976; all data extracted from AIRS.

**Contact:** Mark Sather, Air Quality Analysis Section, U.S. EPA Region 6, Dallas, TX  
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**Analysis Category:** trend analysis

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**Trends Analysis of Weekday-Weekend Ozone and Nitrogen Oxides (NOx) Concentrations in Dallas-Fort Worth and Houston-Galveston, U.S. EPA Region VI**

*Abstract:* **Analysis** - Ozone and NOx data from 1983-1999 from the AIRS database. **Results** - There is a lack of 1-hour ozone exceedances on Sunday in Dallas-Fort Worth, which contrasts with Houston. Morning NOx levels for Dallas-Fort Worth and Houston indicate that Sunday consistently has the lowest morning NOx values of any day of the week. However, the low NOx values on Sunday in Houston are notably higher than the Sunday low NOx values in Dallas-Fort Worth.

**Geographic Area Covered:** Houston and Dallas-Fort Worth, Texas

**Data Used:** Ozone and NOx data from 1983-1999 from the AIRS database.

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phone: (214) 665-8353; e-mail: [sather.mark@epa.gov](mailto:sather.mark@epa.gov)

**Analysis Category:** trend analysis

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**The Passive Ozone Network of Dallas (POND): A Modeling Opportunity with Community Involvement (Part 1) in draft form (Part 2 also beginning to be drafted), US EPA, ORD/NERL**

*Abstract:* **Analysis** - 30 PSD sites in the Dallas-Fort Worth (DFW) metroplex, a region representing 16 counties, successfully measured daily ozone during eight weeks of the 1998 high ozone season. Additionally in 1999, 10 PSD sites successfully measured both 24-hour and 12-hour (day/night) ozone during six weeks of the 1999 high ozone season.

**Results** - High correlations with collocated continuous FRM ozone monitoring data (greater than 0.90), daily ozone contour mapping of the over 24,000 square kilometer area, and a ranking of ozone severity in 12 rural counties for guidance in siting additional monitors (currently being analyzed).

**Geographic Area Covered:** Dallas-Fort Worth metropolitan area, including rural areas up to Oklahoma (greater than 24,000 square kilometer area).

**Data Used:** passive sampling devices (PSD) and federal reference methods (FRM) for ozone; FRM data from AIRS database.

**Contacts:** Jerry Varns and Jim Mulik US EPA, ORD/NERL, RTP, NC

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phone: (214) 665-8353; e-mail: [sather.mark@epa.gov](mailto:sather.mark@epa.gov)

**Analysis Category:** other

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**Analysis of Ozone and Ozone Precursor Trends from the Photochemical Assessment Monitoring Stations (PAMS), LDEQ**

*Abstract: Analysis* - Mark Sather had done the analysis on Ozone and Ozone precursor trends to assess the effectiveness of control strategies in Baton Rouge area. The analysis is focused on design values, and patterns in June-August weekday morning arithmetic means for TMNOC and NOx. Louisiana personnel reviewed and commented on Mark's analysis.

**Results** - LDEQ reviewed the results which indicated that 1-hour ozone design values have decreased significantly.

**Geographic Area Covered:** Baton Rouge, Louisiana

**Data Used:** All data from AIRS database from 1983 - 1999. Data include TNMOC, NOx, Ozone, WS, WD and temperature.

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**Analysis Category:** trend analysis

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**Analysis of Ozone Concentrations in Houston Before and After the Start of School 1990-1998, TNRCC**

*Abstract: Analysis* This analysis looked for long-term trends in air pollutant concentrations to see if ozone concentrations were statistically higher during the week after school started than during the week before. Data were analyzed from three suburban monitors and one rural monitor in Harris County from 1990-1998. The program MAPPER was used to determine "VOC-limited" or "NOx-limited" conditions. Meteorology was examined so that ozone conducive conditions could be taken into account in explaining year-to-year differences. **Results** - Peak weekday ozone concentrations were not statistically higher during the week after school started than they were the week before. However, higher afternoon ozone concentrations were consistently observed on the Sunday following the start of school-- a possible "weekend effect." Weekday NOx concentrations did not increase after the start of school and instead decreased significantly at one site (an industrial NOx influence?). MAPPER showed that "NOx-limited" and "VOC-limited" conditions vary from hour to hour and site to site but for two sites there was a general trend.

**Geographic Area Covered:** Houston, TX

**Data Used:** Hourly ozone diurnal patterns, 1-hour and 8-hour peak ozone concentrations. Hourly NOx diurnal patterns and 1-hour peak NOx concentrations. Hourly NO concentrations (for use in MAPPER). Hourly resultant wind speed, daily maximum temperature, and daily temperature range. All from TNRCC MOTHER database.

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**Analysis Category:** correlation analysis, trend analysis

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**Ten Year Ozone and NOx trends in Dallas/Ft. Worth, TNRCC**

*Abstract: Analysis* - Average morning NOx concentrations (6-9:00 a.m.) on ozone exceedance days were compared to those on all other days during the ozone season. A series of regressions were done to examine the relationships between peak ozone and meteorology, wind speed and morning NOx, and morning NOx and peak ozone. **Results** - Morning NOx concentrations were significantly higher on ozone exceedance days than on all other days. Correlations were found between the variables: (daily average wind speed + max. temperature) and peak ozone and between wind speed and NOx. After statistically removing the meteorological effects, there is still a significant correlation between peak ozone and morning NOx. NOx appears to have a greater influence on peak ozone concentrations at the outlying monitors, suggesting that areas downwind of the urban core are more "NOx-limited".

**Geographic Area Covered:** Dallas/Ft. Worth

**Data Used:** Hourly NOx and ozone concentrations, daily average wind speed, and daily maximum temperature.

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**Analysis Category:** correlation analysis, trend analysis

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**A 1993-1998 Trend Analysis of Nonmethane Hydrocarbon Concentrations at Clinton Drive, TNRCC**

*Abstract:* **Analysis** - A four year trend (1993, 1996-1998) analysis was done of the yearly average NMHC concentrations. Also wind direction plots and diurnal patterns were made for several aromatic species. **Results** - The four year trend analysis showed that substantial reductions from 1993 to 1998 were observed for the aromatics species (toluene, benzene, and xylenes) and for propylene, and some alkanes. Wind direction plots showed that the greatest reductions for aromatics were from the northeast and south. From 1993 to 1997 and 1998, the greatest reductions in aromatic concentrations were during the overnight and early morning hours (midnight until 8 AM).

**Geographic Area Covered:** Monitor at Clinton Drive, Houston, Texas.

**Data Used:** Hourly auto gc NMHC concentrations, hourly resultant wind speed and direction.

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**Analysis Category:** trend analysis

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**Day of the week and month of the year assessments of the frequency of high ozone 1995-1999, TNRCC**

*Abstract:* **Analysis** - Calculated the ozone 1-hour and 8-hour exceedance days. **Results** - There have been no 1-hour ozone exceedance days on Sunday, and very few on Saturday; There have been no 1-hour ozone exceedance days from October to May. Exceedance days peak in August (ranks 1<sup>st</sup>) and July (ranks 2<sup>nd</sup>); The 8-hour ozone exceedance days happened somewhat less frequently on Sunday, but uniformly from Monday through Saturday; The 8-hour ozone exceedance days occur from March to October, and peak in August (ranks 1<sup>st</sup>) and Sept. (ranks 2<sup>nd</sup>); Overall, the 8-hr exceedance pattern is different from the 1-hr exceedance pattern. This has implies that different controls may be needed to address the two NAAQS.

**Geographic Area Covered:** Dallas-Fort Worth

**Data Used:** TNRCC MOTHER database from1995-1999 (4<sup>th</sup> quarter 1999 missing).

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**Analysis Category:** trend analysis

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**Trend of the Ozone Design Values in Texas, TNRCC**

*Abstract:* **Analysis** - Calculated the 1-hour ozone and 8-hour design values by each AQCR area, accounting for missing values. **Results** - Adjusting for missing values as per the Federal Register produces minor variations over using simple “4<sup>th</sup> highest value in 3 years” for the one-hour NAAQS. The design values in all areas declined through the 1980’s, with a slower rate of decline, if any, in the 1990s.

**Geographic Area Covered:** Texas

**Data Used:** EPA methods in Federal Register and the TNRCC MOTHER database from1980-1999 (4<sup>th</sup> quarter 1999 missing).

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**Analysis Category:** trend analysis

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**Dallas -Fort Worth and Houston-Galveston Air Quality Index (AQI) Trend TNRCC**

*Abstract:* **Analysis** - We found that the AQI summaries that we downloaded from the AIRS Web had been calculated with the the old PSI scale, and were thus out of date. Also, CMSA aggregation is not possible with the AIRS Web download. We used six criteria pollutants to calculate the Air Quality Index (AQI) in the Dallas-Fort Worth (DFW) and Houston-Galveston CMSAs based on the new Federal Register procedure. The six pollutants were ozone 8-hour, ozone 1-hour, PM10 24-hr, CO 8-hour, SO2 24-hour, and NO2 1-hour. The Breakpoints for the AQI are show in below table.

**Results** - See tables that follow:

These breakpoints					Equal these AQIs		Category
O <sub>3</sub> (ppm)8-hr	O <sub>3</sub> (ppm) 1-hr	Pm <sub>10</sub> (ug/m <sup>3</sup> )	Co (ppm)	SO <sub>2</sub> (ppm)	NO <sub>2</sub> (ppm)	AQI	
0.000-0.064		0-54	0.0-4.4	0.000-0.034		0-50	Good
0.065-0.084		55-154	4.5-9.4	0.035-0.144		51-100	Moderate
0.085-0.104	0.125-0.164	155-254	9.5-12.4	0.145-0.224		101-150	Unhealthy for sensitive

							group
0.105-0.124	0.165-0.204	255-354	12.5-15.4	0.225-0.304		151-200	Unhealthy
0.15-0.374	0.205-0.404	355-424	15.5-30.4	0.305-0.604	0.65-1.24	201-300	Very unhealthy
	0.405-0.504	425-504	30.5-40.4	0.605-0.804	1.25-1.64	301-400	
	0.505-0.604	505-604	40.5-50.4	0.805-1.004	1.65-2.04	401-500	Hazardous

**Summary of Results:** The results for Dallas-Fort Worth and Houston-Galveston show in Table1-2.

Table 1: AQI of DFW from 1995-1999 (4<sup>th</sup> quarter 1999 missing)

Category	1995		1996		1997		1998		1999	
	# of Days	Percentages	# of Days	Percentages	# of Days	Percentages	# of Days	Percentages	# of Days	Percentages
Good	254	70	255	70	251	69	233	64	187	68
Moderate	62	17	83	23	78	21	90	25	48	17
Unhealthy for sensitive	33	9	23	6	27	7	36	10	29	11
Unhealthy	15	4	5	1	9	2	5	1	6	3
Very unhealthy	1						1		3	1
Hazardous										

Table 2: AQI of Houston-Galveston AQI from 1995-1999 (4<sup>th</sup> quarter 1999 missing)

Category	1995		1996		1997		1998		1999	
	# of Days	Percentages	# of Days	Percentages	# of Days	Percentages	# of Days	Percentages	# of Days	Percentages
Good	227	62	250	68	247	68	238	65	175	64
Moderate	62	17	80	22	58	16	78	21	45	16
Unhealthy for sensitive	35	10	20	5	38	10	28	8	30	11
Unhealthy	21	6	12	3	11	3	12	3	18	7
Very unhealthy	20	5	4	1	11	3	9	2	5	2
Hazardous										

**Geographic Area Covered:** Dallas-Fort Worth and Houston-Galveston CMSAs

**Data Used:** Federal Register algorithm and TNRC MOTHER database from 1995-1999 (4<sup>th</sup> quarter 1999 missing).

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**Analysis Category:** trend analysis

**Comparison of Emissions Inventory with Ambient Measurements for 2 monitors in DFW area on July 1 and 2, 1996 TNRC**

**Abstract: Analysis** - Emissions from 2 gridded areas surrounding Meacham and Hinton Auto-GC monitors were compared to measured concentrations at the monitors themselves, for six morning hours on both July 1 and 2. Comparison was conducted using 50 common PAMS compounds and NO<sub>x</sub>. Analyses included NMHC:NO<sub>x</sub> ratio comparisons; species fingerprint comparisons; reactivity comparisons; examination of mobile source inventory; and ethane/propane analysis.

**Results** - NMHC:NO<sub>x</sub> ratios measured in the ambient air were almost always greater – often much greater – than the same ratios derived from the emissions (this is something that has been found in earlier similar studies). For the EI, selection of different patterns of grid cells – e.g. all 25 cells, vs. single innermost cell – generally had no effect on discrepancy with

ambient ratios.

One large factor in these ratio disagreements was the abundance of ethane and propane in ambient air vs. in emissions.

These two compounds were usually present in the air at much higher concentrations than any other species, especially for the first three hours (3-5 CST start hour, or 4am to 6am local time start hours) of the six-hour period examined. Evidence suggests that these two compounds' elevated ambient concentrations were attributable to aged ethane and propane traveling into the area from outside grids. If true, then the inventory is not necessarily underestimating emissions of these two compounds within the monitor-centered grids.

The mobile source inventory was analyzed to better understand its role in these ratio discrepancies. It was found that in spite of the use of some very detailed and specific data as inputs to the mobile emission factor model, the mobile inventory's NMHC:NO<sub>x</sub> ratios essentially did not change across the first 5 hours of the six-hour study period. This is probably an incorrect representation of what is really happening with on-road mobile source emissions, especially at the Hinton monitor -- the Hinton site is located in the vicinity of a large interstate freeway and numerous arterials which are prone to dramatic congestion during rush hour with concomitant changes in NMHC and NO<sub>x</sub> emissions and their ratios.

**Geographic Area Covered:** TNRCC Emissions Inventory and TNRCC auto-gc data

**Data Used:** Dallas-Fort Worth

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**Analysis Category:** ozone precursors and emission inventories

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#### **Analysis of National PAMS data, TNRCC**

*Abstract:* **Analysis** - PAMS averages (1-hour, 8-hour and Annual Arithmetic Mean) for 22 criteria and hydrocarbon pollutants were compared across sites in Texas and to some extent to other areas throughout the United States. Maps were made showing the locations of monitors across the country. **Results** - Eventually we expect to show citizens of our State how Texas compares to other PAMS states. At this point, however, we have focused on monitoring with the state as part of a strategic environmental indicators project. As expected, Houston and El Paso tend to have the highest readings for many species. The most significant findings have been in seeing which PAMS species carry the least amount of information -- i.e., species such as n-nonane, n-octane, styrene, and others which appear to be at the method detection limit for most observations.

**Geographic Area Covered:** Texas and the other PAMS states

**Data Used:** Summaries of 22 PAMS pollutants for 1998 and 1999. Data extracted from the EPA's AIRS database using the summary feature in AIRS Web

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**Analysis Category:** air quality characterization

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#### **Analysis of the October 7<sup>th</sup>, 1999 Ozone Exceedances in Houston, TNRCC**

*Abstract:* **Analysis** - This was an intensive study which attempted to determine the cause of a 251 ppb ozone reading at Deer Park CAMS 35 and several other 200+ ppb readings in the Houston Ship Channel. During this study we examined historical data to determine trends and to find days with similar winds. We used the meteorological data on Oct. 7th to estimate wind back trajectories. We analyzed the Auto-GC data and Emissions Inventory data in an attempt to discover a possible industrial source signatures. **Results** - From the analysis of the Auto-GC data, surface wind back-trajectories, Lagrangian and photochemical grid modeling, we determined that the exceedance was most likely caused by extreme weather conditions and emissions from an industrial complex to the north-east of the Deer Park site.

**Geographic Area Covered:** Houston

**Data Used:** Hydrocarbons and canister VOCs, ozone, NO<sub>x</sub>, meteorological (i.e. resultant wind speed, resultant wind direction, temperature) data for Houston from 1996 through 1999.

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**Analysis Category:** air quality characterization, source contribution/identification, compare model to ambient air

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#### **A comparison of ambient nonmethane hydrocarbon concentrations collected by two methods: automated gas chromatograph and VOC canister TNRCC**

*Abstract:* **Analysis** - This analysis was done to compare concentrations of ambient nonmethane hydrocarbons measured

by two detection methods in the state of Texas. Texas currently uses seven automated gas chromatographs (AGCs) and approximately forty-five VOC canister/spectrometers to measure ambient NMHCs. Data was analyzed from four urban monitors in Houston and El Paso that have had both types of detectors since 1996 (two sites), 1997 and 1998 (one site each). Daily TNMHC, species averages, and percent differences between the detectors were examined. **Results** - The analysis showed daily variations in TNMHC concentrations as well as variations in concentrations between the two detectors. For roughly half of the sampling days daily TNMHC concentrations from the two detectors were within a percent difference of 25%. A few days showed a significant difference in TNMHC concentrations between the detectors, percent differences greater than 100%. This analysis also suggested that for some species (2-methyl-2-butene, 1-butene, 3-methyl-1-butene, isopropylbenzene, and c-2-hexene) one of the detectors is repetitively measuring higher concentrations than the other, and overall, alkenes appear to be measured at higher concentrations by the VOC canister/spectrometer. This paper seeks to find reasons for these discrepancies by discussing AGC and VOC canister/spectrometer methodologies and possible sources of sample and instrument contamination

**Data Used:** Auto-GC and Canister data throughout Texas from 1997 through 1999 extracted from AIRS

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**Analysis Category:** data validation

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**Cardelino, C.A. and Chameides, W.L. The application of data from photochemical assessment monitoring stations to the observation-based model; Atmospheric Environment Vol 34 (2000) 1853-1860**

*Abstract:* **Analysis** - The observation-based model - a diagnostic model designed to estimate ozone sensitivity to changes in the concentration of volatile organic compounds, nitrogen oxides, and CO - was used to analyze data gathered during the summer of 1995 at three photochemical assessment monitoring sites (PAMS). The sites were located in Washington DC, Bronx, New York, and Houston, Texas, with the first two being categorized as urban/central city commercial and the latter as industrial/suburban. **Results** - Our analysis indicated that: (i) natural hydrocarbons (primarily isoprene) represented a significant fraction of the total hydrocarbon reactivity at all three sites and significantly degraded the efficacy of VOC emission reductions as an O<sub>3</sub> mitigation strategy; and (ii) afternoon NO concentrations at all three sites typically fell to levels at or below the limit of detection of the PAMS instrumentation and, as a result, it was not possible to determine whether O<sub>3</sub> at the sites was more sensitive to reductions in anthropogenic hydrocarbons or nitrogen oxides.

**Geographic Area Covered:** Washington, D.C., Bronx, NY, and Houston, TX

**Data Used:** 1995 PAMS data from Washington, D.C., Bronx, NY, and Houston, TX

**Contact:** Dr. Carlos A. Cardelino and Dr. William L. Chameides

School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA 30332, USA

**Analysis Category:** biogenic emissions, compare model to ambient air, correlation analysis

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**Main H. H. , Hurwitz S. B. , Roberts P. T. (1999) Spatial and Temporal Characteristics of California PAMS and Long-Term Trend Site VOC Data (1990-1997).**

*Abstract:* The EPA, California Air Resources Board (ARB), and the Sacramento, San Joaquin Valley, and Ventura Districts sponsored research into the validation and analysis of the VOC data collected at the Districts' PAMS sites and the ARB long-term trend sites located in Fresno, Los Angeles, and San Diego. This report summarizes VOC data analyses performed for those entities. ARB contact is Don Hammond.

**Geographic Area Covered:** California

**Data Used:** 1994 – 1997 Sacramento, San Joaquin, Ventura County, Los Angeles, San Diego

**Contact:** Barbara Parzygnat, U.S. EPA, Office of Air Quality Planning and Standard, EMAD (MD-14), RTP, NC 27711

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**Analysis Category:** trend analysis

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**MacDonald , Chinkin , Dye , Anderson (1999) Analysis of PAMS Data in California Volume I: The use of PAMS radar profiler and RASS data to understand the meteorological processes that influence air quality in selected regions of California. STI ,**

*Abstract:* The EPA, California Air Resources Board (ARB), Sacramento Metropolitan Air Quality Management District, San Joaquin Valley Unified Air Pollution Control District, and Ventura County Air Pollution Control District sponsored analyses and interpretation of PAMS air quality and meteorological data collected at the Districts' PAMS sites in Sacramento, Fresno, and Ventura Counties and the ARB's long-term trend sites located in Los Angeles and San Diego. Requested tasks encompassed upper-air meteorological data processing and analyses, emission inventory

evaluation, and trends analyses. Results of the data analyses were presented in three volumes. This is the first volume. ARB contact is Don Hammond.

**Geographic Area Covered:** California

**Data Used:** 1996 –1998 Sacramento, Fresno, and Ventura Counties

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**Analysis Category:** potential factors contributing to ozone

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**Haste-Funk , Chinkin (1996) [Analysis of PAMS Data in California Volume II: The use of PAMS data to evaluate regional emission inventories in California.](#) . STI ,**

*Abstract:* The EPA, California Air Resources Board (ARB), Sacramento Metropolitan Air Quality Management District, San Joaquin Valley Unified Air Pollution Control District, and Ventura County Air Pollution Control District sponsored analyses and interpretation of PAMS air quality and meteorological data collected at the Districts' PAMS sites in Sacramento, Fresno, and Ventura Counties and the ARB's long-term trend sites located in Los Angeles and San Diego. Requested tasks encompassed upper-air meteorological data processing and analyses, emission inventory evaluation, and trends analyses. Results of the data analyses were presented in three volumes. This is the second. ARB contact is Don Hammond.

**Geographic Area Covered:** Sacramento, Fresno, and Ventura Counties

**Data Used:** 1996 PAMS air quality and meteorological data from PAMS sites in Sacramento, Fresno, and Ventura Counties

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**Analysis Category:** ozone precursors and emission inventories

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**Wittig , Main , Roberts , Hurwitt (1999) [Analysis of PAMS Data in California Volume III: Trends analyses of California PAMS and long-term trend air quality data \(1987-1997\).](#) . STI ,**

*Abstract:* The EPA, California Air Resources Board (ARB), Sacramento Metropolitan Air Quality Management District, San Joaquin Valley Unified Air Pollution Control District, and Ventura County Air Pollution Control District sponsored analyses and interpretation of PAMS air quality and meteorological data collected at the Districts' PAMS sites in Sacramento, Fresno, and Ventura Counties and the ARB's long-term trend sites located in Los Angeles and San Diego. Requested tasks encompassed upper-air meteorological data processing and analyses, emission inventory evaluation, and trends analyses. Results of the data analyses were presented in three volumes. This is the third. ARB contact is Don Hammond.

**Geographic Area Covered:** California

**Data Used:** PAMS 1987 - 1997 Sacramento, Bakersfield, Fresno, Los Angeles, San Diego

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**Analysis Category:** air quality characterization

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**Blanchard, C. L., and Tanenbaum, S [Spatial Mapping of VOC and NOx-Limitation of Ozone Formation.](#) (Draft Final Report April 14, 2000)**

*Abstract:* This is American Chemical Council (formerly Chemical Manufacturers Association) sponsored the report which summarizes and synthesizes the results of previous studies that have used ambient aerometric data for qualitatively predicting whether ozone formation at specific times and locations is limited by the availability of volatile organic compounds (VOCs) or oxides of nitrogen (NOx). Procedures of using the ambient data are of interest for corroborating the predictions of photochemical air quality simulation models (PAQSMs). Also, the data-based analyses have been used to characterize VOC and NOx limitation for many different days and many different days and many different ozone seasons (versus limited PAQSM episodes), or in areas lacking PAQSM application. For this study applications were obtained and summarized for six regions of the country.

**Geographic Area Covered:** The regions and time periods covered by the analyses are:

Central California 4 to 8 years (1991-98), Texas 2 to 7 years (1993-99), Southern California 3 to 4 years (1994-97), Atlanta (July and August 1990), Northeast U.S. (June-August 1995), Lake Michigan area (10 episode days June-August 1991).

**Data Used:** PAMS data in Houston, Dallas, and El Paso, TX, Central and Southern, CA, and Northern U.S. in addition to other data sets

**Contacts:** Charles Blanchard and Shelly Tanenbaum, Envair, 526 Cornell Ave. Albany CA 94706

**Analysis Category:** compare model to ambient air, correlation analysis, air quality characterization

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**Blanchard, Tanenbaum, Ladner, and Roberts Enhancement of Measurement-Based Analysis of Preferences in Planned Emission Reductions (Ozone M.A.P.P.E.R.) and Application to Data from the Beaumont-Port Arthur, Dallas-Fort Worth, El Paso, and Houston Metropolitan Areas (1994-1999) Envair and STI prepared for TNRCC**

*Abstract:* Calculations of the extent of reaction were carried out for all sites and days having appropriate data during the period 1994 through 1999 (end of July). Statistical distributions and maps of the median extent of reaction on high-ozone days were used to summarize the results. Individual M.A.P.P.E.R. plots were prepared for 87 combinations of day and region. Results – The 1993 COAST data indicated that for high-ozone days, sites within central Houston (Crawford, Lang, Texas Commerce Tower, Galleria) and nearer to the ship channel (Clinton, Mae Drive, HRM sites 1, 3, 7, and 11) showed median extent less than 0.6 (VOC limited). Large geographic areas having median extent exceeding 0.9 (NO<sub>x</sub> limited) occurred to the north (Aldine), southeast (Galveston, Smith Point, Gilchrist), and east (Beaumont, West Orange, S43S). Data from 1994 through 1999 generally supported the patterns observed during the COAST study. However, the larger data set suggested a smaller area of NO<sub>x</sub> limitation, with Aldine, Northwest Harris, Beaumont, and West Orange, appearing transitional between VOC and NO<sub>x</sub>-limitation. The numbers of monitoring sites having measurements of both ozone and “NO<sub>x</sub>” were limited in the Dallas-Fort Worth and El Paso than in Houston. The five sites in Dallas and Tarrant counties, located within the urban Dallas-Fort Worth area, all showed median extent within a range that is transitional between VOC and NO<sub>x</sub> limitation (0.6 to 0.9). Denton Airport, approximately 50 km to the north of the urban center, was NO<sub>x</sub>-limited on most of its high ozone days. El Paso, the median extents of reaction on high ozone days were in the range of 0.26 to 0.52, strongly indicating that peak ozone formation was VOC limited.

**Geographic Area Covered:** The regions and time periods covered by the analyses are:

Central California 4 to 8 years (1991-98), Texas 2 to 7 years (1993-99), Southern California 3 to 4 years (1994-97), Atlanta (July and August 1990), Northeast U.S. (June-August 1995), Lake Michigan area (10 episode days June-August 1991).

**Data Used:** PAMS data in Houston, Dallas, and El Paso, TX

**Contacts:** TNRCC

**Analysis Category:** compare model to ambient air, correlation analysis, air quality characterization

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**Validation of PAMS VOC Data in the Mid-Atlantic Region, February 1999, H. Main and P. Roberts, Sonoma Technology, Inc.**

*Abstract:* Sonoma Technology, Inc. validated data from 12 PAMS sites for 1996 and 1997. Sonoma had previously validated 1995 data under a CRC-funded contract. They had also validated North Carolina data from “PAMS-like” stations under a separate contract. Some data from 1994 for Philadelphia and Washington, DC, had also been previously validated. After this report, the state and local agencies operating the PAMS sites made corrections, the revised data was posted in AIRS, and Sonoma is expected to update the NARSTO archive.

**Geographic Area Covered:** mid-Atlantic states

**Data Used:** 1996-1997 data from mid-Atlantic region PAMS sites

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**Analysis Category:** data validation

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**Characteristics of Volatile Organic Compounds in the Mid-Atlantic Region, November 30, 1999, H. Main, S. Hurwitt, P. Roberts, Sonoma Technology, Inc.**

*Abstract: Analysis* - This report analyzed concentrations of various hydrocarbons at Photochemical Assessment Monitoring Stations (PAMS sites) in the Mid-Atlantic Region, from 1995-1997. This report assessed the importance of motor vehicle-related emissions in the region. Interpretative analyses included assessment of ozone formation potential, the relative age of an air mass, and multivariate analysis of VOC sources. STI performed the following tasks in this regard: Assessed general characteristics of VOCs; Assessed spatial and temporal issues; Investigated source identification (qualitative); Assessed air mass age (an investigation of transported vs. fresh emissions); Reviewed day of week distributions; Assessed trends. **Results** - Motor vehicle emissions are the dominant source of VOC at the PAMS sites in the region as evidenced by the relationships among the abundant hydrocarbons, sample compositions, and spatial and temporal analyses. Morning NMHC/NO<sub>x</sub> ratios for all sites in the Mid-Atlantic region in 1997 generally were VOC-limited indicating that VOC controls may be effective in reducing ozone levels. Decreasing NO<sub>x</sub> levels under these conditions may result in increased ozone, due to less NO titration of ozone. The data indicate that at some sites, nearby non-motor vehicle related sources significantly impacted the site including possible industrial sources of toluene, pentanes, decane, xylenes, 1,2,4-trimethylbenzene, propane, propene, nonane, and styrene. The 1997 data at New Brunswick indicate in several analyses that the site has many more characteristics of a Type 2 or 3 site than a Type 1 or 4 site. Arendtsville appears representative of a Type 1/4 site. All other site classifications appear consistent with the data.

**Geographic Area Covered:** mid-Atlantic states

**Data Used:** 1995-1997 data from mid-Atlantic region PAMS sites

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**Analysis Category:** air quality characterization, source contribution/identification, trend analysis, transport analysis

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**Technical Assistance to MARAMA on EPA Cumulative Exposure Project (CEP): Review of Air Toxics Modeling, January 1999, P.T. Roberts, H.H. Main, S.B. Hurwitz, Sonoma Technology, Inc.**

*Abstract:* This report is a review of toxics modeling conducted by EPA under the Cumulative Exposure Project, comparing model-estimated concentrations of various toxic air pollutants with ambient concentrations in Philadelphia, New Brunswick (NJ), and Baltimore. Ambient concentrations were for 1996, while the model estimates were for 1990, so the comparison illustrates analyses that could be performed when 1996 modeling is completed. In addition, the ambient data is from PAMS monitoring sites, which only operate during the summer, while the model estimates are annual averages. Morning data were used for the comparisons, because a comparison of summer morning data to 24-hour, year round canister data for 8 HAPs at Philadelphia showed good agreement. Since EPA plans to conduct another round of toxics modeling using the ASPEN model and 1996 emissions estimates, the methods demonstrated in this report may be useful in assessing the results of the EPA 1996 modeling.

**Geographic Area Covered:** mid-Atlantic region

**Data Used:** 1999 PAMS data from sites in Philadelphia, New Brunswick, and Baltimore

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**Analysis Category:** compare model to ambient air

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**Reconciliation of an Emissions Inventory with PAMS Ambient Monitoring Data in the Mid-Atlantic Region, May 31, 2000, Till Stoerkenius and Michele Jimenez, ENVIRON International Corporation.**

*Abstract: Analysis* – PAMS data collected in the mid-Atlantic region have recently been validated and summarized. This study compared ambient speciated NMHC and NO<sub>x</sub> data from PAMS monitors in Washington, DC and Baltimore, MD with emission inventories for these cities compiled for this study by E.H. Pechan (2000). In addition to including local point and area source data, these inventories have been specifically designed to provide the best available estimates of on-road mobile source emission by incorporating local information on mobile source activity levels and fuel characteristics. **Results** - Morning ratios (6-9 am) of monitored Total Non Methane Hydrocarbons (TNMHC) to NO<sub>x</sub> were greater on average than corresponding ratios calculated by emissions ratios. This could be due to some combination of underestimation of VOC emissions and overestimation of NO<sub>x</sub> emissions or the influence of other factors which cause uncertainties in these comparisons. (These factors include temporal and spatial allocation of emissions, speciation of emissions, local atmospheric chemistry, and monitoring uncertainties.) Comparison of individual NMHC species abundance in the ambient data with abundance in the total inventory and selected inventory source categories in Washington confirmed that gas powered mobile sources dominate at this location and indicate several key discrepancies between that mobile source speciation profile and the ambient data. The main discrepancies are a greater fraction of light hydrocarbons in the ambient data than in the inventory, and much greater toluene, n-butane, and xylene in the inventory relative to the ambient data.

**Geographic Area Covered:** mid-Atlantic region (Virginia and Maryland)

**Data Used:** speciated NMHC and NO<sub>x</sub> data from Washington D.C. (McMillan) and Baltimore (Essex) PAMS sites

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**Analysis Category:** source contribution/identification

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**Using PAMS Data to Compare and Evaluate Two Emission Inventory Tools: Receptor Models and EMS-95**

*Abstract: Analysis* - This paper compares a photochemical modeling inventory with an inventory derived from a seven-source receptor model for PAMS monitors in the Lake Michigan area (the urban areas of Milwaukee, Chicago, and Gary). The Emissions Modeling System (EMS-95) PAMS Analysis Tool is used to examine the photochemical inventory. The analysis focuses on type 2 and 3 sites and on the early morning (6-9 am) sampling period because measured VOC mass is generally high, emissions (particularly from vehicles) are high, photochemical reactions are low, and meteorological conditions (low wind speed, temperatures, mixing heights) generally favor local source influences rather than transported emissions from distant sources. Both hydrocarbon and NO<sub>x</sub> emissions are examined, as well as hydrocarbon/NO<sub>x</sub> ratios. Estimates from both models are expressed as relative contributions to total mass, and the analysis is restricted to the PAMS species. The ability of the two models to account for the ambient

concentration of individual hydrocarbon species is also compared. **Results** - Results vary from site to site, but some generalizations are apparent. Both models significantly underestimate the amount of ethane and propane in the ambient atmosphere, which indicates that either (1) a primary source of these species is missing from the models or (2) source profiles for the sources in the models are incorrect for these species. The photochemical modeling inventory significantly overestimates the amount of toluene and xylenes in the ambient atmosphere, but the receptor model estimates are quite close to ambient measurements for these species. The difference between the model performance for these species may be due to differences in profiles or inventory mass for major solvent sources. The photochemical inventory slightly overpredicts the ratio of HC/NO<sub>x</sub>, while CMB slightly underpredicts the ratio of HC/NO<sub>x</sub>. Implications of these ratios, as well as specific allocations to the various source sectors, are discussed.

**Geographic Area Covered:** Lake Michigan PAMS Area

**Data Used:** Lake Michigan PAMS

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**Analysis category:** Evaluation of Ozone Precursors, Emission Inventory Evaluation, Receptor Modeling, Assessment of Source Contribution/Identification

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### **AMDAS PAMS Data Analysis Workbook: An Illustrated Guide to the Analysis of PAMS data Using the Ambient Monitoring Data Analysis System (AMDAS)**

*Abstract:* **Analysis** - Use of the AMDAS data analysis tool is illustrated via an application to data collected in the Baton Rouge ozone nonattainment area since the start of the PAMS program. AMDAS was used to prepare data summaries, analyze key relationships between PAMS species, TNMOC/NO<sub>x</sub> ratios, and relationships with ozone, a wind direction analysis for source contributions, weekday/weekend comparisons, and long-term concentration trends.

**Results** - Procedures described in this workbook demonstrate how the AMDAS data analysis software package can assist users in reviewing, summarizing, and identifying key features of their PAMS data. Several important features of the Baton Rouge data relevant to the above analyses were identified.

**Geographic Area Covered:** Baton Rouge, LA nonattainment area

**Data Used:** 1995-1998 PAMS data from Capitol, New Pride, and Bayou Plaquemine.

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**Analysis Categories:** PAMS Data Validation, Spatial and Temporal Characteristics, Biogenic Emissions, Factors Contributing to Ozone, Source Contribution/Identification, Correlation Analysis, Trend Analysis

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### **The Potential Use of PAMS Ozone Precursors as a Predictive Tool for Ozone Forecasting**

#### **Georgia Environmental Protection Division/Ambient Monitoring Program**

*Abstract:* Atlanta has been forecasting ozone concentrations since 1996. Throughout the Atlanta forecasting history a number of tools have helped to improve the forecasting process including linear regression models, the UAM-FM, and the SODAR PA1-LR. In 1996 certain patterns in the Conyers (type 3), Georgia PAMS site indicated that hydrocarbon data may be useful in predicting ozone events in the Atlanta area. Isoprene, total PLOT hydrocarbons (PLOT<sub>HC</sub>) and a select group of ten (10) compounds within this total column normally found below detection limits were initially identified as the best candidates for use in ozone prediction. In 1997 and 1998 the hydrocarbon data was made available for use by the ozone prediction team. Several questions must be considered in the process of verifying the quasi-empirical evidence. These questions have provided the framework for the evaluation process. Some of them include; is there a chemical consistency among stations for the predictors, can the chemical data aid in reducing the number of faulty ozone predictions (over-prediction on non-exceedance days and under-prediction on exceedance days), and can the hydrocarbon data aid the Atlanta prediction team to predict isolated ozone event days and/or the start and end of a multiple day event. It is hoped that the final outcome of this work will aid Georgia in improving the statistical prediction models and provide a means of including the hydrocarbon data in the UAM-FM model. This paper will provide the preliminary results to some of these questions.

**Geographic Area Covered:** Atlanta

**Data Used:** Conyers (type 3), Georgia PAMS site

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**Analysis Categories:** Potential Factors contributing to Ozone, Other

**APPENDIX B**  
**USE OF PAMS SITES IN STUDIES/ANALYSES 1999-2000**  
**BY US EPA REGION**

**TABLE A**  
**REGION I – USE OF PAMS SITES IN STUDIES/ANALYSES 1999-2000**

Area (Non-Attainment Class)	Site Name (Type)	Year							Total
		94	95	96	97	98	99	00	
Boston (Serious)	Borderland (#1-#3) <sup>1</sup>		1			1	1		3
	Lynn (#2)		1			1	1		3
	Long Island (#2A)		1			1	1		3
	Newbury (#3)		1			1	1		3
	Acadia National Park, ME (#4)		1			1	1		3
Greater Connecticut (Serious)	Sherwood Island (#1/#3) <sup>1</sup>	1			1	1			3
	East Hartford (#2)	1			1	1			3
	Hamden (#2A)	1			1	1			3
	Stafford (#3)	1			1	1			3
	Cape Elizabeth, ME (#4)	1			1	1			3
Portsmouth-Dover-Rochester, NH-ME (Serious)	Brentwood, NH (#1)					1	1		2
	Kittery, ME (#2)					1	1		2
Providence-Pawtucket-Fall River, RI-MA (Serious)	West Greenwich (#1)		1			1	1		3
	East Providence (#2)		1			1	1		3
	Borderland (#1-#3) <sup>1</sup>		1			1	1		3
	Truro, MA (#4)		1			1	1		3
Springfield, MA (Serious)	Agawan (#1)		1			1	1		3
	Chicopee (#2)		1			1	1		3
	Ware (Quabbin Summit) (#3)		1			1	1		3

<sup>1</sup> PAMS Site is used for assessment of more than one PAMS network area

**TABLE B**  
**REGION II – USE OF PAMS SITES IN STUDIES/ANALYSES 1999-2000**

Area/Class	Site Name/Type	Year							Total
		94	95	96	97	98	99	00	
New York-New Jersey-Long Island, NY-NJ-CT	New Brunswick, NJ (#1/#4) <sup>1</sup>		3	4	3	3	1		14
	Bronx Botanical Gardens (#2)	1	4	3	1	1	1		11
	Queens Community College (#2A)		1			1	1		3
	Sherwood Island (#1/#3) <sup>1</sup>	1			1	1			3

<sup>1</sup> PAMS Site is used for assessment of more than one PAMS network area

**TABLE C**  
**REGION III – USE OF PAMS SITES IN STUDIES/ANALYSES 1999-2000**

Area/Class	Site Name/Type	Year							Total
		94	95	96	97	98	99	00	
Baltimore, MD (Severe)	Fort Meade (#1/#3) <sup>1</sup>		3	2	2	1	1		9
	Essex (#2)		1	3	2	1	1		8
	Clifton Park (#2A)		3	2		1	1		7
	Living Classroom (#2A)		1			1	1		3
	Aldino (#3)		3	2	2	1	1		9
	Lums Pond, DE (#4/#1) <sup>1</sup>		3	2	2	1	1		9
Philadelphia- Wilmington-Trenton, PA-NJ-DE-MD (Severe)	Lums Pond, DE (#1/#4) <sup>1</sup>		3	2	2	1	1		9
	East Lycoming Lab (#2)		3	3	2	1	1		10
	Camden, NJ (#2A)		1		2	2	1		6
	Rider College, NJ (#3)		4	3	3	2	1		13
	New Brunswick, NJ (#1/#4) <sup>1</sup>		1	4	3	3	1		12
Washington, DC-MD- VA (Serious)	Corbin, VA (#1)		2	2	2	1	1		8
	Caroline County (#1 – met)					1	1		2
	McMillan Reservoir (#2)		2	2	2	1	1		8
	Fort Meade, MD (#3/#1) <sup>1</sup>		3	2	2	1	1		9
	Lums Pond, DE (#4/#1) <sup>1</sup>		3	2	2	1	1		9

<sup>1</sup> PAMS Site is used for assessment of more than one PAMS network area

**TABLE D**  
**REGION IV – USE OF PAMS SITES IN STUDIES/ANALYSES 1999-2000**

Area/Class	Site Name/Type	Year							Total
		94	95	96	97	98	99	00	
Atlanta, GA (Serious)	Yorkville (#1)			1		1	1		3
	South Dekalb (#2)		1	1	1	1	1		5
	Tucker (#2A)					1	1		2
	Conyers (#3)		1	2	2	2	1		8
	Monticello (#4)					1	1		2

**TABLE E**  
**REGION V – USE OF PAMS SITES IN STUDIES/ANALYSES 1999-2000**

Area/Class	Site Name/Type	Year							Total
		94	95	96	97	98	99	00	
Lake Michigan States, IL-IN-WI-MI	Braidwood (#1)		1			2	1		4
	Milwaukee UWM (#2)		1			2	1		4
	Chicago NWU (#2)		1			2	1		4
	Chicago-Jardine (#2)		2	1	1	2	1		7
	Gary IITRI (#2)		1			2	1		4
	Harrington Beach, WI (#3)		1			2	1		4
	Northbrook (#3)		1			2	1		4
	Holland, MI (#3)		1			2	1		4
	Camp Logan (#4)		1			2	1		4
	Manitowoc, WI (#4)		1			2	1		4

**TABLE F**  
**REGION VI – USE OF PAMS SITES IN STUDIES/ANALYSES 1999-2000**

Area/Class	Site Name/Type	Year							Total
		94	95	96	97	98	99	00	
Beaumont, TX (Moderate)	Sea Rim State Park (#1)	3	3	3	3	4	4		20
	Jefferson Co. Airport (#2)	3	3	3	3	4	4		20
Baton Rouge, LA (Serious)	New Pride (#1/#3)	2	3	3	3	4	3		18
	Capitol (#2)	2	3	3	3	4	3		18
	Bayou Plaquemine (#3/#1)	2	3	3	3	4	3		18
Dallas-Fort Worth, TX (Serious)	Hinton (#2)	8	8	9	8	9	9		51
El Paso, TX (Serious)	Ascarte Park (#1)	4	4	4	5	6	6		29
	Chamizal (#2)	4	4	4	5	5	5		28
	UTEP (#3)	4	4	4	5	6	6		29
Houston-Galveston- Brazoria, TX (Severe)	Aldine (#1/#3)	8	8	9	9	10	9		53
	Clinton Dr. (#2)	9	9	9	9	9	8		53
	Deer Park (#2)	9	9	9	9	9	8		53
	Galleria (#2A)	9	9	9	9	9	8		53
	Galveston (#3/#1)	9	9	9	8	9	8		53
	Tomball/NW Harris (#4)	9	9	9	9	10	9		55

**TABLE G**  
**REGION IX – USE OF PAMS SITES IN STUDIES/ANALYSES 1999-2000**

Area/Class	Site Name/Type	Year							Total
		94	95	96	97	98	99	00	
Sacramento, CA (Severe)	Elk Grove-Bruceville (#1)	3	3	5	4	2	1		18
	Natomas Airport (#2)	3	3	4	3	1	1		15
	Del Paso (#2A)	3	3	4	3	1	1		15
	Folsom (#3)	3	3	4	3	1	1		15
	New Folsom (#3)	3	3	4	3	1	1		15
San Diego, CA (Serious)	Camp Pendleton (#1)	3	3	4	3	1	1		15
	El Cajon (#2)	3	3	3	3	1	1		14
	Overland (#2A)	3	3	3	3	1	1		14
	Alpine (#3)	3	3	3	3	1	1		14
San Joaquin Valley, CA (Serious)	Arvin (Bkrsfld) (#1/#3)	3	3	4	3	1	1		15
	Golden State Ave. (Bkrsfld) (#2)	3	3	4	3	1	1		15
	Clovis Vills (Fresno) (#2)	3	3	4	3	1	1		15
	Madera (Fresno) (#3/#1)	3	3	4	3	1	1		15
	Parlier (Fresno) (#1/#3)	3	3	4	3	1	1		15
South Coast/SEDAB, CA (Extreme/Severe)	Hawthorne (#1)	3	3	3	3	1	1		14
	Burbank (#1/#2)	3	3	3	3	1	1		14
	Pico Rivera (#2)	3	3	3	3	1	1		14
	Banning (#2)	3	3	3	3	1	1		14
	Azusa (#3)	3	3	3	3	1	1		14
	Upland (#4/#1)	3	3	3	3	1	1		14
Venture County, CA (Severe)	Emma Wood Beach (#1)	3	3	4	3	1	1		15
	El Rio (#2)	3	3	4	3	1	1		15
	Simi Valley (#3)	3	3	5	4	2	1		18

Demerjian, K. L., 2000. A review of national monitoring networks in North America. *Atmospheric Environment* 34, 1861-1884.