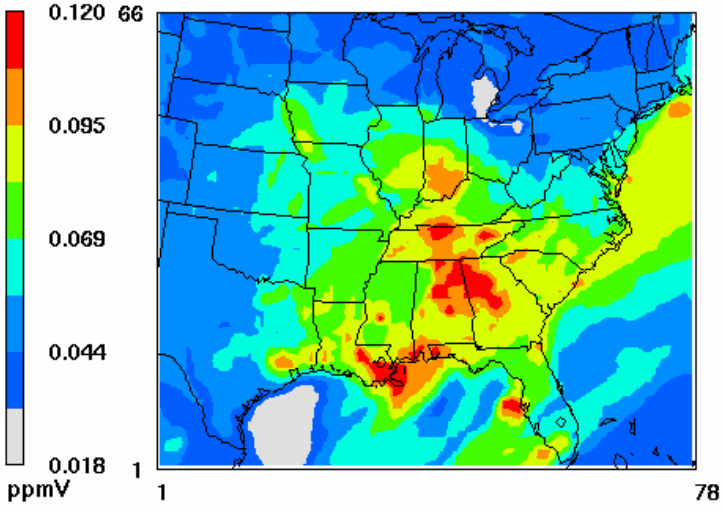
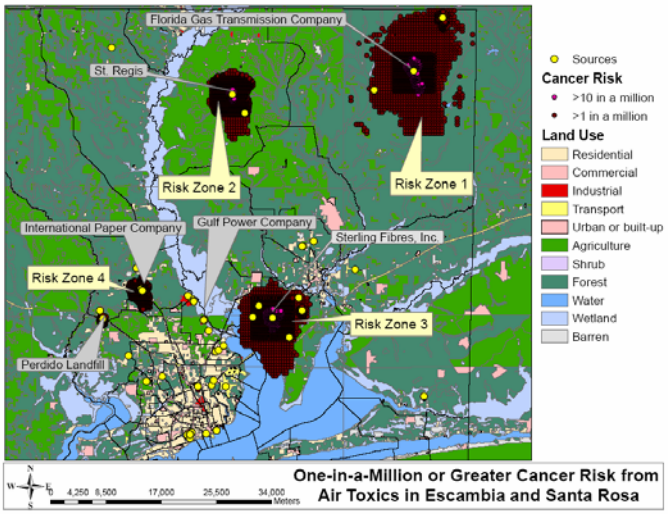
PERCH

Partnership for Environmental Research and Community Health

Air Quality Study
Final Report





An Assessment of Particulate Matter, Ozone, and Air Toxics in Escambia and Santa Rosa Counties

PERCH Air Quality Study – Executive Summary

December 15, 2007

Georgia Institute of Technology

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Executive Summary

Introduction

The Partnership for Environmental Research and Community Health (PERCH) is a comprehensive, multi-partner, and multi-disciplinary study to determine if a connection exists between elevated levels of illness in Northwest Florida and the levels of toxic pollutants in the area. The study was commissioned by the U. S. Congress in 2002 and is led by investigators at the University of West Florida. As part of this overall effort, a team of researchers at the Georgia Institute of Technology was challenged to develop an appropriate study to investigate if a connection exists between air pollution / air toxics and adverse human health outcomes in the Pensacola area, specifically Escambia and Santa Rosa counties. Over the course of five years (2002-2007), the PERCH Air Quality Study (PAQS) was conducted in three phases.

Based on a preliminary review of ambient monitoring data, available information regarding emissions, other studies, and discussions with various stakeholders, there are three classes of air pollutants that are of particular concern in the Pensacola area: ground-level ozone, fine particulate matter, and air toxics. Unfortunately, there is no scientific or community consensus regarding which of the three classes of pollutants poses the greatest health risk to the Pensacola community, nor is there a standard methodology by which to make inter-comparisons. In Phase I of this study, existing information was used to assess and prioritize local, urban, and regional threats to human health associated with air toxics and criteria pollutants (ozone and particulate matter) in the Pensacola area. In Phase II, a pilot field study was conducted to investigate the relationship between regional-scale measures of air quality provided by the existing regulatory-based air quality monitoring network, and neighborhood-scale measures of air quality that may be more representative of human exposures in the Pensacola area. In Phase III, a multi-pronged modeling and analysis approach was used to identify the primary contributors to PM, ozone, and air toxics pollution and quantify their relative contributions to local ambient concentrations (and hence potential exposures). The intent of this final phase was to provide local decision makers with the relevant technical information one would need to begin developing a comprehensive air quality management strategy.

Phase I: Assessing the Relative Risks Associated with Criteria and Air Toxic Pollutants in the Pensacola Area

Given limited resources with which to conduct a study of air quality and its potential impact on human health in the Pensacola area, it is rational to attempt to identify the type of pollution that may be presenting the greatest health risk in order to focus resources on that problem. Such a comparative analysis is made difficult, however, by the variety of acute and long-term health outcomes related to the different pollutants. While it is recognized that these various health outcomes are incommensurable, it is important to find ways in which they may be compared in order to prioritize and use efficiently the available research resources, and so that the community may likewise focus its efforts on reducing potential risks.

In this initial phase, a rudimentary study was conducted to assess the per capita costs related to the health impacts from ozone, particulate matter, and air toxics at concentrations observed contemporarily in Pensacola. A second, independent assessment focused on the health benefits that would be obtained if pollutant concentrations in the Pensacola area were decreased such that they were no longer considered a risk for any individual. It is important to note that the methodologies are considerably different for the two studies, and thus the costs cannot be directly compared with the benefits. However, within each assessment, it is reasonable to compare the ***relative*** estimates of costs and ***relative*** estimates of benefits. It is in this sense that both analyses suggested that, of the three pollutants of concern, elevated concentrations of particulate matter may pose the greatest health risk.

Costs of Health Impacts from PM, Ozone, and Air Toxics in Pensacola. (Note: due to different methods used to estimate, these costs should not be directly compared to the benefits below.)

	$/year/person (Medium)
PM	$1838.21
Ozone	$952.69
Air Toxics (Total)	$1.02

Benefits of reduced risks from PM, Ozone, and Air Toxics in Pensacola. (Note: due to different methods used to estimate, these benefits should not be directly compared to the costs above.)

	$/year/person (Medium)
PM	$34.00
Ozone	$0.70
Air Toxics (Total)	$3.50

In other Phase I activities, existing and on-going air quality studies pertinent to the Pensacola region were reviewed. This included the Gulf Coast Ozone Study, the West Florida Ozone Study, and the Fall line Air Quality Study.

Key Findings: For this initial assessment of particulate matter, ozone, and air toxics in Escambia and Santa Rosa Counties, rudimentary analyses suggest that **particulate matter likely presents the greatest risk to human health generally related to air quality in the Pensacola region**. It should be recognized however, that there could be highly localized areas for which other pollutants could pose a greater risk.

Implications: Of the three classes of pollutants, ozone is the most well understood pollutant, though it may not pose the greatest health risk. Less is known about particle pollution and air toxics. In terms of allocating PAQS resources, the investigation's ensuing primary focus (i.e. in Phases II and III) will be on PM, secondary on air toxics, and tertiary on ozone.

Phase II: Summer 2003 Pilot PERCH Air Quality Study

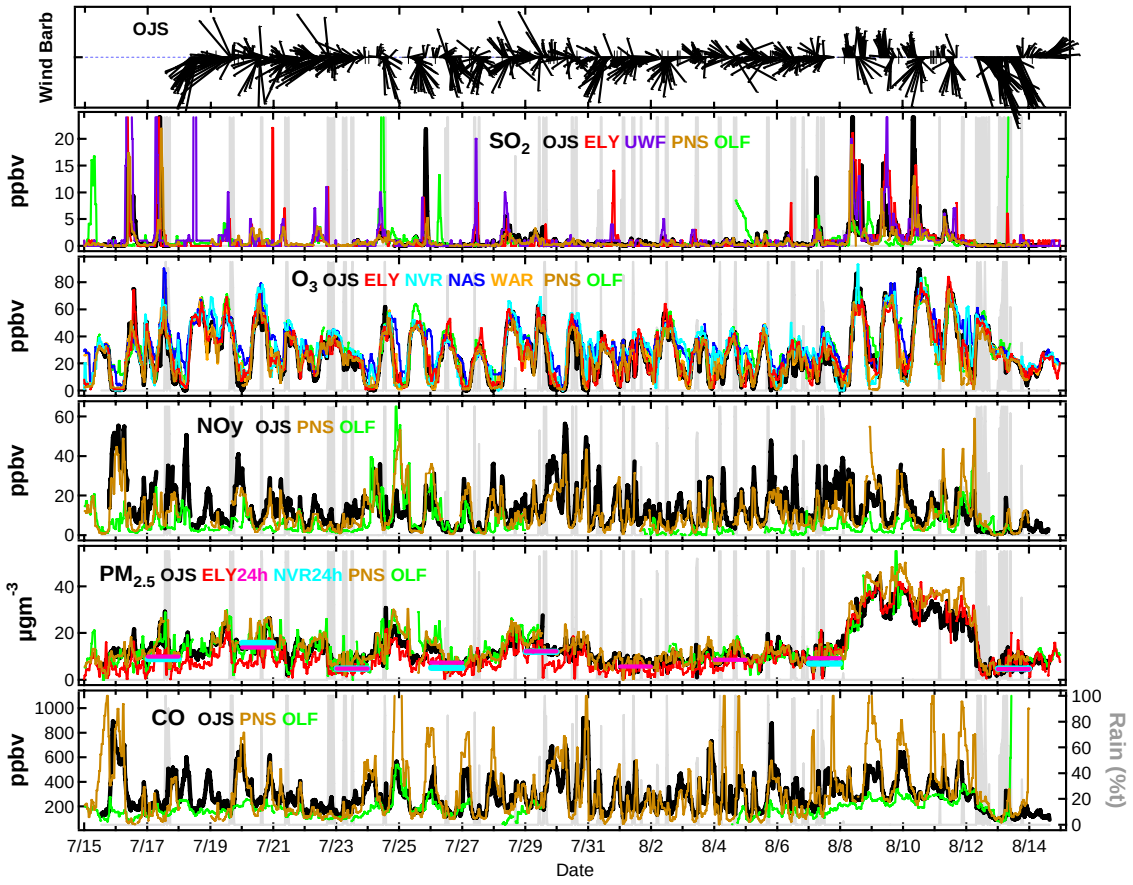
Past and current air monitoring and modeling activities in the Pensacola area have been aimed at assessing regulatory compliance and developing strategies for mitigating pollutant loads. These initiatives are well posed and provide leaders at the Florida

Department of Environmental Protection (FL DEP) and in the Pensacola area with the technical information needed to make rational decisions for managing air quality in the region. While there may be some relevance, none of these, however, are specifically targeted for understanding and managing the full array of independent and synergistic human health impacts created by exposure to criteria and hazardous air pollutants. The goal of the PERCH 2003 Pilot Air Quality Field Study is to assess air quality (PM, ozone, and air toxics) at a neighborhood scale and to learn how it relates to regional air quality, which is more well understood. In this phase of the study, the Georgia Tech Mobile Air Quality Laboratory (MAQL) was deployed in a populated region of the Pensacola area from mid-July to mid-August 2003 and where high frequency (on the order of 1 minute to 1 hour averages) atmospheric chemical and physical data at a single site were collected.

After careful consideration of many potential sites, and in consultation with a team from the University of South Florida conducting a study on "Assessing the Impact of Environmental Hazard Exposure on the Health Status of Geographically Defined Populations in Escambia and Santa Rosa Counties," the MAQL was deployed on the grounds of the OJ Semmes Elementary School (OJS). OJS is located in a residential area centrally located in relation to the main business district to the south, the large industrial facilities to the north, the airport to the east, and the interstate to the west. Monitoring at the OJS site was conducted from July 15 to August 14, 2003. Care was taken to assure the quality of the data, with the methodology and standard operating procedures well documented.

The MAQL fully deployed and operational at the OJ Semmes ES site on July 18, 2003

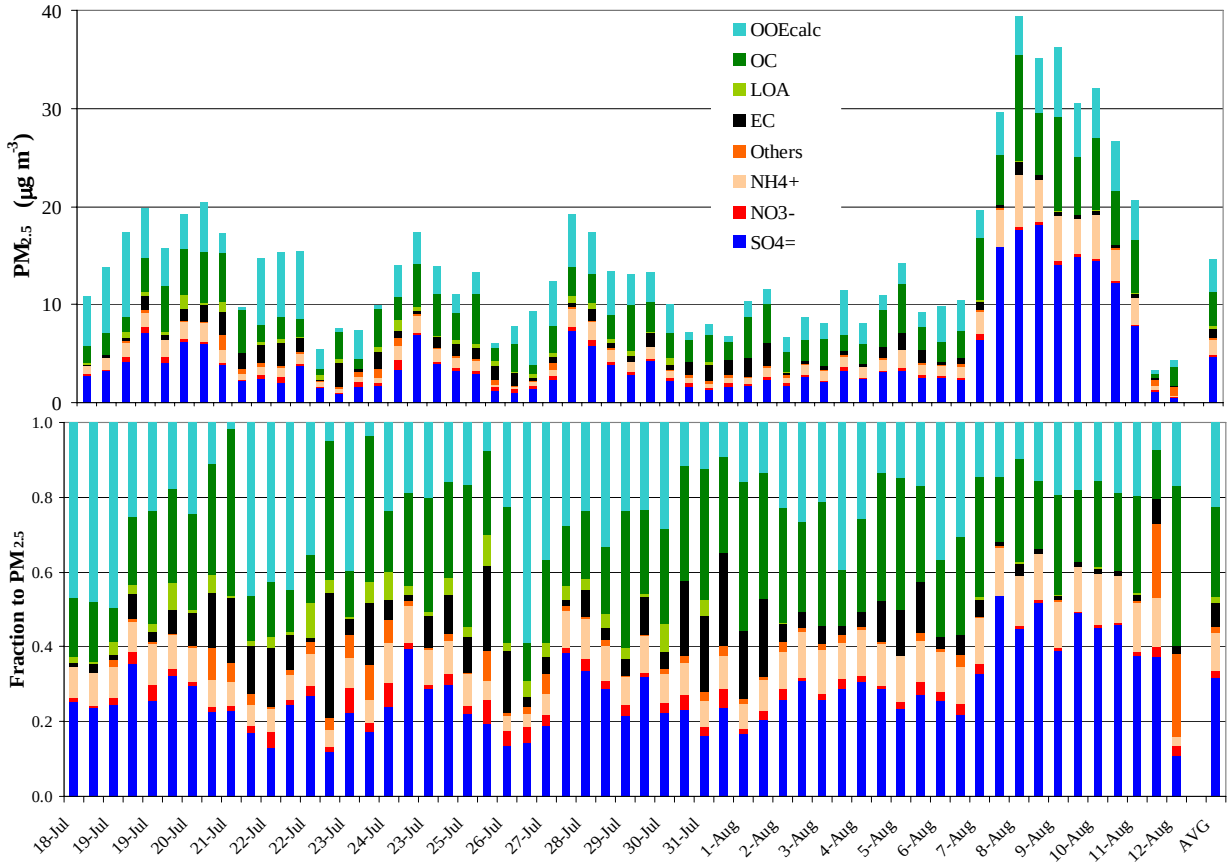
The period July 15 to August 14, 2003 was characterized by three distinctly different periods: The first three weeks until August 7 were characterized by relatively frequent showers and thunderstorms in late mornings and early afternoons; this period was followed by four dry sunny days from August 8th to 11th with convectively driven winds, reaching the campaign's lowest relative humidities, highest daytime temperatures, and highest pollutant concentrations. The third distinct period was characterized by strong southerly flow carrying moisture from the Gulf of Mexico that precipitated over the area, resulting in the highest rainfall amounts and overall lowest air pollution concentrations of the entire study period.



Trend of the major air pollutants measured at OJS and other sites between July 15 and August 15, 2003

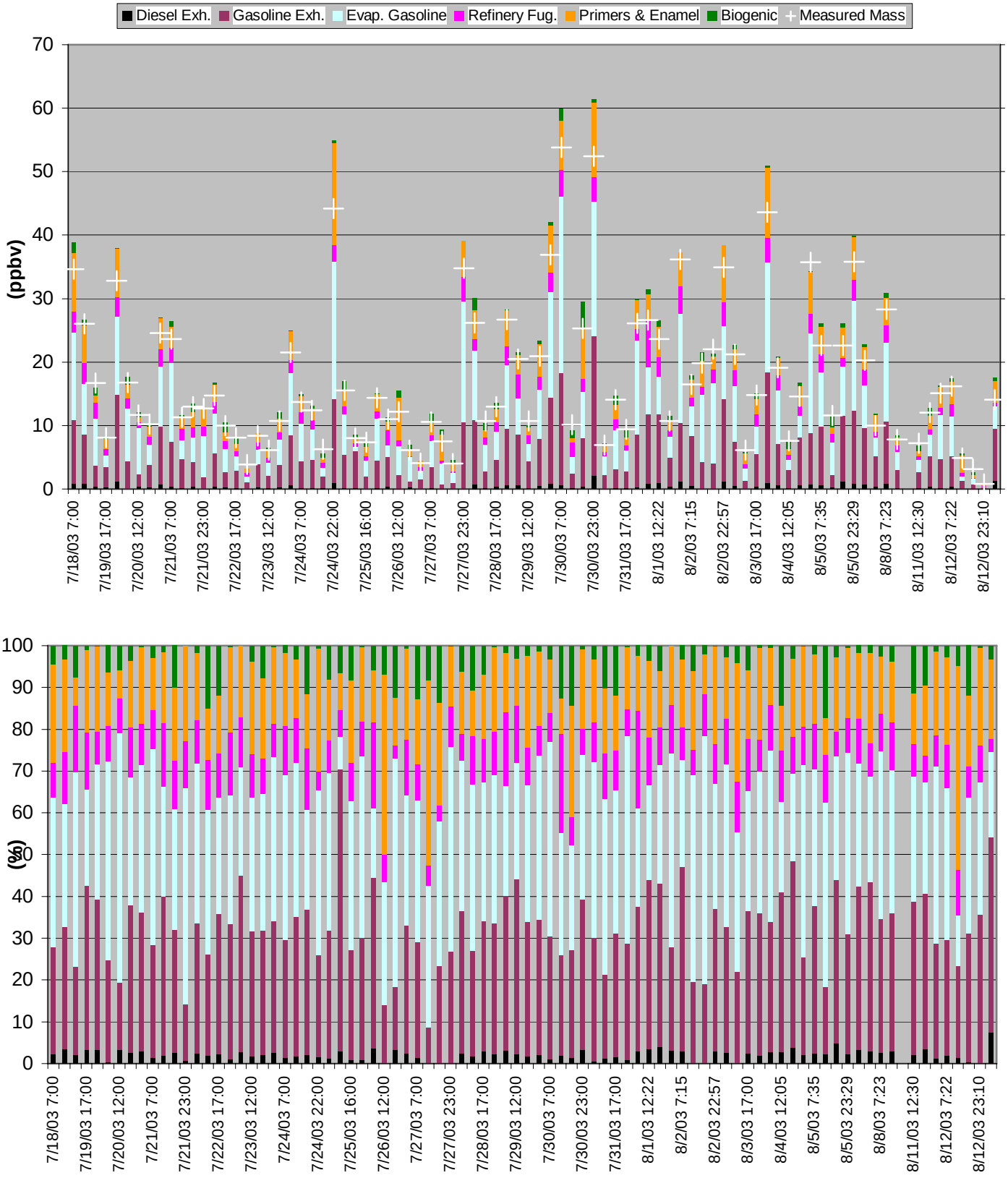
While ozone showed the expected diurnal cycles with daytime maxima at all sites, SO_2 was more sporadic, with the highest concentrations associated with northerly flow at OJS. Both ozone maxima and SO_2 impacts increased during the dry phase, which was also the period of maximum $PM_{2.5}$ and CO background levels. The diurnal variability of CO correlated well with NOy in a bimodal way. The bimodal appearance of CO and NOy seem to be governed by local traffic sources. A linear regression of all CO and NOy data from the entire dataset however, yields a slope of 12.4 ±0.2, which is significantly more than what would be considered typical of mobile source emissions. Hence, the OJS site seems to be influenced by mixed emissions from multiple sources most of the time. $PM_{2.5}$ mass concentrations were lowest during the most intense rainfall associated with strong southerly flow during the last two days of the campaign.

In assessing the composition of the $PM_{2.5}$, roughly half of the mass is inorganic with sulfate being the largest contributor. The organic fraction is characterized by both primary particulate (particulate that is emitted directly into the atmosphere) and secondary particulate (particulate that is formed in the atmosphere from other constituents). Secondary organic aerosol formation was greatest during the 4-day dry period and corresponding with the highest $PM_{2.5}$ mass concentrations. While experience suggests that the presence of sulfate is often associated with coal combustion, organic aerosols, both primary and secondary, can originate from many sources.



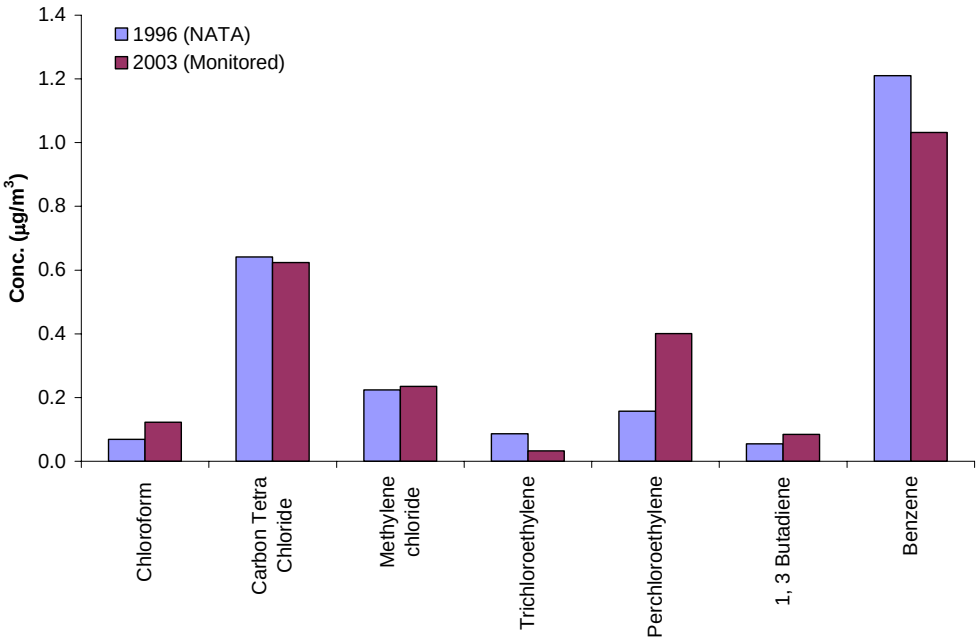
Fine particulate matter composition measured at OJS between July 18 and August 12, 2003.

A separate analysis of the gaseous Volatile Organic Compounds (VOCs) sampled at OJS, for which some of the particulate organic carbon may be closely related, suggested that gasoline related sources were the dominant contributors (about 65%) during the study at the OJ Semmes Elementary School site. Other significant contributions were associated with primers and enamel (18%), refinery fugitives (10%), biogenics (5%), and diesel exhaust (2%).



Mass (top) and fractional (bottom) VOC contributions from each source at the OJS site July 18 to August 12, 2003

Among the 83 VOC compounds we monitored, seven pollutants were part of the 32 NATA air toxics. They include benzene, chloroform, carbon tetrachloride, methylene chloride, trichloroethylene, perchloroethylene, and 1,3-butadiene. We also monitored toluene, which is a toxic air pollutant by Clean Air Act definition, but it was not considered in the NATA assessment. While there is little reason to expect that the 2003 monitored values should necessarily compare well with the 1996 NATA values given the significant differences in methods, time, and space, and recognizing that little can be gained from such a comparison, it is interesting nonetheless that the concentrations for these seven toxic pollutants agree as well as they do. The implication is that the 1996 NATA estimates are reasonable.



Comparison of 1996 modeled NATA and 2003 VOC/toxics monitoring data in Pensacola.

Key findings: analyses showed **sulfate was a large fraction of the observed ambient $PM_{2.5}$ loading**, with high concentrations most often associated with northerly flow. Additionally, **organic carbon was likewise found also to be a large fraction of the ambient $PM_{2.5}$ loading**, with the highest secondary organic aerosol formation concurring with peak $PM_{2.5}$ mass concentrations. Results from a separate study of volatile organic compounds showed that **gasoline related sources are the dominate contributors to ambient gaseous VOC concentrations**, suggesting that these same sources are significantly contributing to the organic aerosol fractions – both primary and secondary. Finally, a limited comparison of air toxic concentrations measured at the OJ Semmes Elementary School and air toxic concentrations estimated for the Pensacola area by the 1996 NATA, showed remarkable (perhaps fortuitous) agreement despite many differences in method, and temporal and spatial scales.

Implications: coal and gasoline combustion were observed to account for most of the Pensacola atmosphere's particle load during a high pollution event. Additional analyses (see Phase III) are needed to discern between local and regional sources, however.

Phase III: Comprehensive Air Quality and Air Toxics Modeling and Analyses

Comprehensive PM Analysis.

During the Phase II field study, the period August 8 to 12 brought in a polluted dry air mass from northerly directions. Secondary sulfate was shown to cause a large fraction of the $PM_{2.5}$ mass concentration during the 4-day pollution episode at OJS and the greater metropolitan area including the ~170 km distant Gulfport, Mississippi area, constituting more than 40% of the fine PM mass. A systematically higher sulfate loading was observed during the day (50 ±3 %) exceeding the one at night (43 ±3 %), while the percent sulfate to total sulfur, i.e. the fraction of sulfur oxidized into the particle phase showed less pronounced differences. Applying a charge balance based on the sulfate-ammonium-nitrate system to each individual sample collected indicated a clearly more acidic aerosol during the polluted period with systematically higher acidity during daytime than during nighttime, corroborating previous indications for photochemically driven heterogeneous radical chemistry and secondary aerosol formation during daytime.

Incorporating data from EPA's Speciation Trends Network (STN), the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, and the South-Eastern Aerosol Research and Characterization Study (SEARCH) network, the coastal and central areas of Mississippi and Alabama, and even extending up to their northern regions, seemed to share the same "air shed" with the greater Pensacola metropolitan area and the NW-FL region, as the sulfate fractions were uniformly maximized on August 10, 2003.

In further analyses, the ratio of organic mass (OM) to organic carbon (OC) averaged 1.7 ±0.2 for the entire pollution period and 1.8 ±0.1 for the daytime intervals only, indicating a likely influence from daytime photochemical processing in an oxidizing atmosphere. Since this factor is particularly sensitive to the level of OC oxygenation, only two main sources are thought to influence it substantially, i) atmospheric oxidation, or ii) incomplete low-temperature combustion. Regarding the latter, open biomass burning in the form of prescribed or wild fires provide such combustion regimes, yielding emissions with OM/OC of 1.6 ±0.4. Further both satellite imagery, modeled back trajectories, and additional analyses suggest that distant fires occurring concurrent to this episode could have influenced the observed airmass in Pensacola.

Key finding: although the effective contributions from satellite-detected ground fires could not be quantified, detailed analyses showed that they played an important role in the polluted event observed at the O. J. Semmes elementary school during the Phase II field study.

Implication: in addition to coal and gasoline combustion, open fires were also a noted source of particles during the observed pollution event.

Source Apportionment of PM2.5 in the Pensacola area.

The Fall line Air Quality Study (FAQS) $PM_{2.5}$ episode chosen for re-analysis of impacts at Pensacola comprises a 13-day period between July 5 and July 18, 2001, a representative poor air quality episode in the Southeastern U.S. The initial phase of analysis quantified the modeled 24-hour average $PM_{2.5}$ concentration and composition for the episode. The maximum 24-hour average modeled at Pensacola during the episode was 16 $\mu g/m^3$, and the episode average concentration was 10 $\mu g/m^3$. Relative to other cities analyzed in the FAQS domain, $PM_{2.5}$ at Pensacola resembles other areas in terms of predominant constituents, but the modeled $PM_{2.5}$ exhibits two important differences. First, episode average $PM_{2.5}$ is considerably lower at Pensacola (10 $\mu g/m^3$) compared to Atlanta (16 $\mu g/m^3$), Macon (14 $\mu g/m^3$), Columbus (14 $\mu g/m^3$), or Augusta (16 $\mu g/m^3$). Second, although the relative proportion of $PM_{2.5}$ constituents at Pensacola resembles other cities, Pensacola is clearly distinct in that more sulfate, but very little nitrate, comprises $PM_{2.5}$ than at other cities. On an episode average basis, sulfate comprises 67% of the modeled total $PM_{2.5}$ concentration at Pensacola, with ammonium comprising 15%. Primary OC (11%) is the next most prevalent component. In this modeled episode, biogenic secondary organic aerosols are modeled to compose little $PM_{2.5}$ at Pensacola.

On an episode average basis, sulfate concentrations at Pensacola appear to be most sensitive to emissions from states other than Florida or Alabama (43%), followed by Alabama SO_2 emissions (24%) and Florida SO_2 emissions (16%). That Pensacola sulfate concentrations are most sensitive to boundary conditions (BC) is not a surprising result, but the diurnal variability warrants further consideration. Over the course of the 13 simulated days, sulfate concentrations at Pensacola are sensitive to BC as little as 9% and as much as 87%. Sulfate concentrations at Pensacola are sensitive to Alabama SO_2 emissions as little as 0% and as much as 56%. Sulfate concentrations at Pensacola are sensitive to Florida SO_2 emissions as little as 3% and as much as 49%. Even Tennessee, from which emissions must travel a considerable distance, contributes up to 10% on certain days. Meteorology, specifically the variability of prevailing winds throughout the domain during this episode, explains the variability in contributing source regions to sulfate concentrations in Pensacola. High sensitivity of sulfate concentrations in Alabama are expected, but prevailing northerly winds are a necessary condition to contribute to high sulfate concentrations at Pensacola. Under these conditions, there is little to no zonal transport of pollutants along the Gulf of Mexico coastline from source regions such as Mobile, New Orleans, or Houston.

Like for sulfate concentrations, day-to-day variability in ammonium is significant; however, the source regions are different. On an episode average basis, ammonium concentrations at Pensacola appear to be most sensitive to NH_3 emissions from Florida (54%), followed by Alabama NH_3 emissions (20%), and other states' emissions (16%). Unlike sulfate concentrations, which appear to be most sensitive to a regional source (Alabama) of SO_2 emissions, ammonium concentrations are most sensitive to a local source. The diurnal variability in ammonium sensitivity is modest compared to sulfate. Ammonium concentrations at Pensacola are sensitive to Florida NH_3 emissions as little as 33% and as much as 86%. Ammonium concentrations at Pensacola are sensitive to Alabama NH_3 emissions as little as 0.2% and as much as 37%. Ammonium concentrations at Pensacola are sensitive to boundary conditions as little as 2% and as

much as 35%. South Georgia contributes up to 22% on certain days. Like sulfate, sensitivity varies considerably with meteorology.

Key findings: Consistent with observations in Phase II, **sulfate constitutes half or more of the particulate load** in the Pensacola area for a modeled 2001 pollution episode. Rather than local sources, however, **sulfate concentrations were more sensitive to distant sources**. In contrast, ammonium was more sensitive to local sources.

Implications: like ozone, a combination of regional and local controls may be necessary to effectively manage particle pollution in the Pensacola area.

Assessment of Risks from Air Toxics in Escambia and Santa Rosa Counties using EPA's Regional Air Impact Modeling Initiative (RAIMI) Tools.

The Regional Air Impact Modeling Initiative (RAIMI) consists of a set of tools designed "to evaluate the potential for health impacts as a result of exposure to multiple contaminants from multiple sources, at a community level of resolution." RAIMI integrates emission inventory, dispersion model, and risk estimation in a GIS environment and allows estimation and representation of cancer and non-cancer risks from air toxics. Conceptually RAIMI follows the typical steps involved in a multi-source multi-pollutant risk assessment of air toxics. As a first step, an emission inventory of all sources and pollutants released in the community of interest is developed. An air dispersion model such as the Industrial Source Complex (ISC) model predicts ambient air concentrations at a number of receptor locations using emission source characteristics (e.g., exit gas velocity, exit gas temperature, stack height), meteorological parameters (e.g., wind speed and direction, vertical temperature profile, atmospheric stability), land use, and terrain characteristics of the study area. An exposure model takes into account the activity patterns and demographic composition of the area to estimate the actual exposures from ambient concentrations. In the next step, using the toxicity information for different pollutants, individual as well as cumulative cancer and non-cancer risks are estimated. RAIMI is currently capable of estimating cancer and non-cancer risks only from the inhalation pathway.

Application of the RAIMI system with the 1999 National Emission Inventory (NEI) for greater Pensacola indicated four concentrated hotspots of potentially elevated risk in the community.

Risk Zone 1 – Northern Santa Rosa County

Risk Zone 1 is in northern Santa Rosa County in the northeastern part of the model domain in the vicinity of three emission sources: a petroleum/natural gas extraction operation, a natural gas pipeline compressor station, and a landfill. A maximum cumulative risk of 48 in a million is predicted by RAIMI. The peak risk is attributed almost entirely to formaldehyde emissions from the natural gas compressor station, which operates large, natural gas-fired reciprocating internal combustion engines. The surrounding area is nearly entirely forested and rural, suggesting the assumption of continuous exposure may not be appropriate.

However, any individuals that do reside within approximately 2 km of the facility could experience chronic cancer risks on the order of 10 in a million or more.

Risk Zone 2 – Northern Santa Rosa County

Risk Zone 2 is in northern Santa Rosa County in the north central part of the model domain in the vicinity of two emission sources: a petroleum/natural gas extraction operation and a landfill. A maximum cumulative risk of 23 in a million is predicted by RAIMI. The peak risk is attributed almost entirely to formaldehyde and toluene emissions from the petroleum/natural gas extraction operation. As in Risk Zone 1, the surrounding area is nearly entirely forested and rural, suggesting the assumption of continuous exposure may not be appropriate. However, any individuals that do reside within approximately 0.5 km of the facility could experience chronic cancer risks on the order of 10 in a million or more, and a large radius of approximately 5 km around the operation may be subject to chronic cancer risks on the order of 1 in a million or more.

Risk Zone 3 – Pace Community in Santa Rosa County

Risk Zone 3 is near the Pace community in Santa Rosa County on the other side of Escambia Bay from Downtown Pensacola in the south central part of the model domain in the vicinity of six emission sources: four industrial plants and two landfills. A maximum cumulative risk of 709 in a million is predicted by RAIMI. The peak risk is attributed almost entirely to acrylonitrile emissions from the acrylic fiber manufacturing operation. Unlike Risk Zones 1 and 2, Risk Zone 3 features diverse land uses, including residential areas. Therefore, it is possible that nearby residents could be chronically exposed to elevated pollutant concentrations and could experience cancer risks on the order of 10 in a million or more. Residents up to 10 km away from the operation could be subject to chronic cancer risks on the order of 1 in a million or more. The presence of spatially smaller high risk areas in the vicinity of the landfills are also noted in this risk zone. (Note: The magnitude of the estimated risk (709 in a million) in Risk Zone 3 was found to be overstated by approximately a factor of 20 and caused by an error in the NEI. Inspection of other estimated risks surrounding the facility indicate more typically values of 36 to 45 in a million, consistent with the order of magnitude of risk estimates for other industrial operations.)

Risk Zone 4 – Cantonment Community in Escambia County

Risk Zone 4 is near the Cantonment community in Escambia County about 10 km northwest of Downtown Pensacola in the southwestern part of the model domain in the vicinity of a large pulp and paper manufacturing operation. A maximum cumulative risk of 5.4 in a million is mostly attributed to methanol, acetaldehyde, benzene and xylene, which are used as chemical solvents in the pulping operation. The surrounding area is largely forested and agricultural, but some residential, commercial, and urban land uses are present, suggesting that residents could be exposed to elevated concentrations and higher cancer risks.

Non-cancer risk due to exposures to air toxics from point sources is not of much concern in Pensacola. Two very small clusters have a Hazzard Index of greater than one, however, both these areas are within the industrial land use zones.

Key Findings: Three areas in Santa Rosa County and one area in Escambia County were estimated to have a possible elevated risk of cancer due to emissions from point sources (also called stationary or industrial sources). Only the Pace community in Santa Rosa County had a significant residential presence in close proximity to the industrial source that is primarily accountable for the elevated risk. While of concern, the estimated risks are of a magnitude that is consistent with risks found near other industrial sources.

Implications: With some exception for residential areas very near or within the industrial zones identified as potential hotspots, analyses using RAIMI appear to suggest that toxic **emissions from point sources are not a widespread source of cancer risk via the inhalation pathway** in the Pensacola area (with the caveat that other pathways were not studied).

Risk Assessment of Mobile Source Air Toxics in Escambia and Santa Rosa Counties.

Similar to the point sources analysis described above, we model mobile source emissions as a series of point source emissions occurring along the roadways. The following are some general observations based on our analysis of cancer risks. Almost all the regions around modeled roads in both counties are subject to a cancer risk of 1 in a million or greater; large parts of Escambia and a few regions close to main roadways in Santa Rosa are subject to 10 in a million greater cancer risk. Many parts of urban Escambia are subject to estimated cancer risks of more than 100 in a million. In Santa Rosa, 100 in a million or greater cancer risk is mainly concentrated along Interstate 10 (I-10) and US 98 roadways. At a few locations spread over urban Escambia, the estimated cancer risks exceed 1000 in a million with a couple of locations exceeding a cancer risk of 10,000 in a million. In Santa Rosa, comparatively fewer regions are subject to large cancer risks (only four to five locations have an estimated cancer risk of more than 1000 in a million).

In light of the excessively high estimated cancer risk at some locations, we further analyzed those high-risk locations. The maximum cancer risk of 11,600 in a million occurs on the Blue Angel Parkway near its intersection with US-98 in the southwestern part of Escambia. The point of 11,600 in a million risk is located at a distance of 2m from the centerline of the road, indicating that the point of maximum risk is on the roadway. Further, the estimated cancer risk drops to 14 in a million at a distance of 82m and to 4 in a million within 300m from the centerline of the roadway. Thus, we believe that these excessively high risks are likely an artifact of the uniform receptor grid that is overlaid on the region without regard to the location of the point source emissions. In these cases, the model receptor is located on or very close to a modeled roadway point source which in turn leads to high modeled pollutant concentrations and subsequent high estimates of risk.

We analyzed the contributions of various pollutants to estimated cancer risk at a few locations in order to ascertain a general trend across the entire study area. This analysis was conducted at three locations each for Escambia and Santa Rosa. These three locations correspond to the three highest estimated cancer risks in the two counties. In both counties and at all locations, formaldehyde, benzene, and butadiene together contribute to more than 95% of the estimated cancer risk. The relative contribution of these three pollutants is identical at the three locations in Escambia while it varies slightly across the three locations in Santa Rosa. Benzene contributes most, followed by formaldehyde and butadiene.

As in the case of cancer risks, almost all locations are subject to a hazard index (HI) of more than one for non-cancer risks. Higher values of HI (10-100 range) are concentrated in the urbanized areas of Escambia and along I-10 and US 98 in Santa Rosa. A few locations also show a HI of more than 100. The highest value of HI in Escambia is 800 and it occurs on Blue Angel Parkway, the same location where the maximum cancer risk was found. Analysis of the variation of non-cancer risk as a function of distance from road centerline revealed patterns similar to cancer risk analysis. At the locations with the highest HI values, HI decreased to less than 2 at a distance of less than 100m.

Key Findings: **elevated cancer and non-cancer risks due to mobile sources are ubiquitous in the Pensacola area** with higher risks generally along more highly traveled roadways. Arising from the emissions of formaldehyde, benzene, and butadiene from cars and trucks, **risk diminishes by several orders of magnitude a few hundred meters off the roadway**.

Implications: **residential and other populated areas immediately adjacent to busy roadways may incur significantly elevated cancer and non-cancer risks.**

Assessment of Acute Health Risks from HCl and HF emissions from Plant Crist

The 1999 NEI revealed that all HCl (7,559 tons) and HF (153 tons) emissions were reported to come from a single facility, Plant Crist, a coal-fired power plant located approximately 10 miles north of downtown Pensacola. Though these are not carcinogenic, we assess if these sizable emissions could be a source of short-term health risks. Acute risks are typically computed analogously to chronic non-cancer risks using a short-term modeled concentration and acute risk-based threshold, such as Acute Guideline Exposure Levels (AEGL), Threshold Limit Values (TLV), and Reference Exposure Levels (REL) compiled by the U.S. EPA, the American Council of Governmental Industrial Hygienists, and the Occupational Safety and Health Administration. For assessing the acute health risks related to the significant emissions of HCl and HF from Plant Crist, we used an alternative approach developed by the Georgia Environmental Protection Division (EPD).

The Georgia EPD approach is convenient for modeling applications since it provides, with an appropriate margin of safety, a conversion of occupational exposure safety thresholds (typically 8 hours) into more relevant averaging periods (e.g., 24 hours) for assumption of continuous exposures. Using risk-based criteria such as RfC, AEGL, REL, and TLV, an acceptable ambient concentration (AAC) can be calculated for each

pollutant to represent acceptable risk levels for acute (15-minute and 24-hour average) time periods as well as chronic exposures (annual average). Short-term acute limits (e.g., 15 minute averages) are derived from 1-hour average model results. Reviewing the appropriate data for HCl yields an AAC of 20 $\mu g/m^3$ on an annual average basis and 700 $\mu g/m^3$ on a 15-minute average basis. HF has AAC of 5.85 $\mu g/m^3$ on a 24-hour average basis and 230 $\mu g/m^3$ on a 15-minute average basis.

The modeling protocol followed a similar approach as the cancer risk assessment in RAIMI by using the same dispersion model (ISCST3) and meteorological data set. Source parameters were obtained by a review of Florida DEP permit application files. Results of the modeling show that HCl and HF ambient impacts from Plant Crist are 90 to 98% below the risk-based AAC.

Key finding: though the emissions of HCl and HF from Plant Crist are sizable, they do not appear to present a significant acute health risk via inhalation.