CHAPTER 4
REGIONAL MODELING AND EVALUATION

Chapter 4. Regional Modeling and Evaluation

4.1 Introduction

Regional air quality modeling is used to determine the concentration impact in time and space to the community due to emissions from a single or group of known toxic compounds and emissions sources. The model simulated concentration contours of toxic compounds are translated into a pattern of health risk based upon compound potency risk factors. The regional modeling provides a mechanism to disperse the emissions from a variety of source categories as well as individual sources to estimate a mass consistent impact throughout the modeling domain. This analysis complements the data analytical techniques used to assess concentration and risk from the data acquired at the fixed monitoring sites.

Several comments received from reviewers of the Draft MATES III report were directed at the regional modeling analysis and evaluation. The key areas addressed:

- The need for a direct comparison between the regional modeling analyses generated for both MATES II and MATES III;
- The simulation performance elemental carbon ($EC_{2.5}$) compared with observations measured during the MATES III monitoring program; and
- The adequacy of the comparison of simulated risk to risk calculated based on monitored data at the MATES III sites.

Several additional comments suggested modifications to the modeling assumptions including model configuration and specific emissions allocation. These included suggestions to:

- Modify (increase) the number of layers in the model domain;
- Evaluate alternate methodologies to calculate vertical dispersion; and
- Review the emissions inventory in particular, the percentage apportionment of EC emissions released from ships.

The regional modeling analysis and evaluation presented in this document attempts to answer the key issues and suggestions identified through the review process. Most noteworthy, this document presents a newly-generated recreation of the MATES II modeling analysis that is consistent in model application, inventory development, and modeling assumptions to the MATES III analysis described in the following sections.

For MATES III, the Comprehensive Air Quality Model with Extensions (CAMx) enhanced with a reactive tracer modeling capability (RTRAC) (Environ, 2006) provided the dispersion modeling platform and chemistry used to simulate annual impacts of both gaseous and aerosol toxic compounds in the Basin. The version of the RTRAC "probing tool" in CAMx used in the

modeling simulations includes an air toxics chemistry module that is used to treat the formation and destruction of reactive air toxic compounds.

Modeling was conducted on a domain that encompassed the Basin and the coastal shipping lanes located in the Southern California Bight portions of the Basin using a grid size of two-squared kilometers. (Figure 4-1 depicts the MATES III modeling domain. The shaded portion of the grid area represents the extension of the domain beyond that used for MATES II). An updated version of the 2007 AQMP emissions inventory for model year 2005, which included detailed source profiles of air toxic sources, provided mobile and stationary source input for the MATES III CAMx RTRAC simulations. An additional back-cast of the 2007 AQMP emissions inventory was generated for 1998 to project emissions for use in the new simulation covering the MATES II monitoring period.

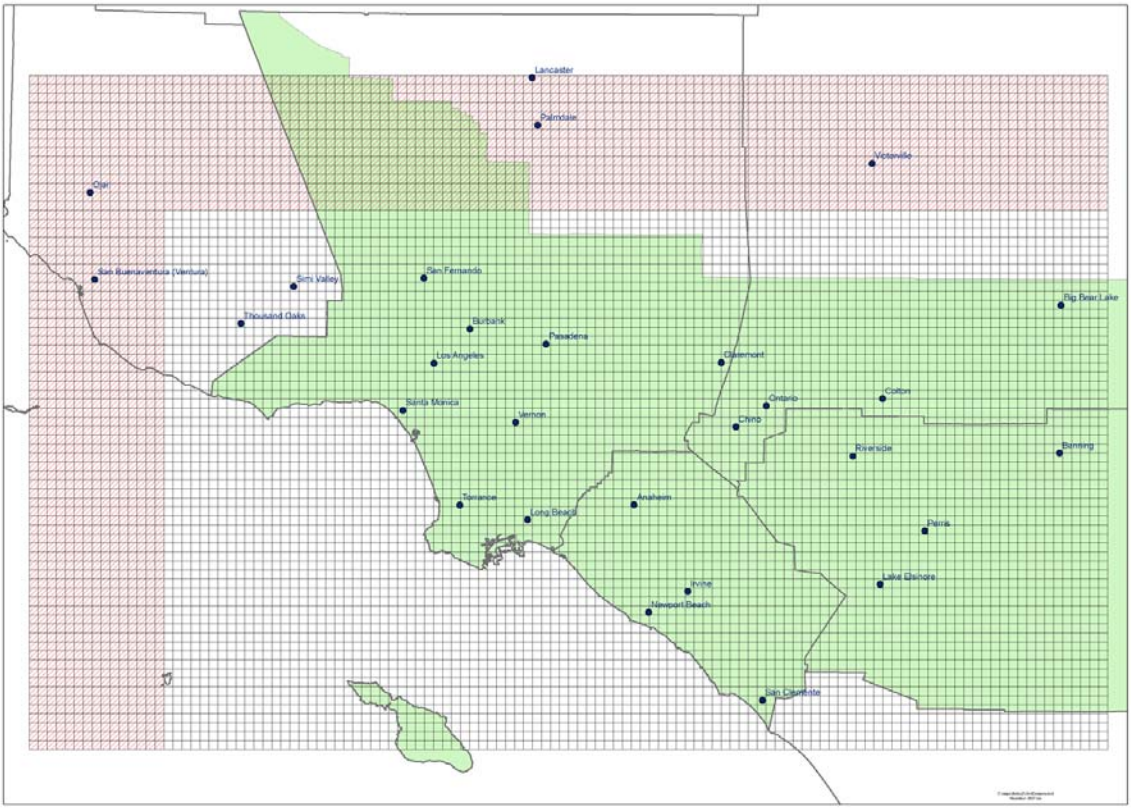

Figure 4-1
MATES III Modeling Domain.
(Shaded area highlights the grid extension to the MATES II modeling domain).

Grid-based, hourly meteorological fields generated from the MM5 (PSU/NCAR 2004) mesoscale meteorological model using four dimensional data assimilation, and National Weather

Service model initializations for April 1998 through March 1999 and all days in 2005 provided the dispersion profile for the simulations.

4.2 Background

In the MATES II analysis, the Urban Airshed Model with TOX (UAMTOX) chemistry was used to simulate the advection and accumulation of toxic compound emissions throughout the Basin. UAMTOX was simulated for a protracted two-squared kilometer grid domain that overlaid the Basin. The analysis relied on the 1998 emissions projection from the 1997 AQMP and meteorological data fields for 1997-98 generated from objective analysis using a diagnostic wind model. These tools were consistent with those used in both the 1997 and 2003 AQMP attainment demonstrations.

Peer review of the 2003 AQMP modeling strongly suggested that future AQMP attainment demonstrations utilize more state-of-the-sciences tools that utilize updated chemistry modules, improved dispersion algorithms and mass consistent meteorological data. The recommendations were placed in action for the 2007 AQMP where the dispersion platform moved from UAM to CAMx and the diagnostic wind meteorological model was replaced by MM5 prognostic model. CAMx, coupled with MM5 input using the "one atmosphere" gaseous and particulate chemistry, was used to simulate both episodic ozone and annual concentrations of $PM_{2.5}$.

4.3 MATES III vs. MATES II: Key Modeling Assumptions

The MATES II modeling analysis was conducted using the UAM dispersion platform and the TOX chemistry package. The UAMTOX model was simulated using diagnostic meteorological model output and 1999 emissions data. At the time when the MATES II simulations were conducted, UAM was considered a recommended dispersion platform by U.S. EPA through their modeling guidance documents. The TOX chemistry package was one of a select few chemistry packages available for consideration in the analysis.

The MATES III simulations were conducted using the contemporary CAMx – MM5 coupled with the RTRAC chemistry. The decision to move away from UAMTOX for the current analysis was twofold: (1) to build upon the advances gained in the 2007 AQMP in annual particulate modeling using the peer recommended state-of-the-science modeling tools, and (2) to provide analysis consistency with the 2007 AQMP $PM_{2.5}$ attainment demonstration. (Note: the regional modeling analysis presented in this final document differs from that presented in the draft to account for modifications made to modeling assumptions, most notably the use of a land-use based vertical dispersion algorithm and changes in EC shipping emissions allocations in response to comments received from reviewers).

It is difficult to fully assess the impact caused by the shift in modeling platforms and chemistry modules. Table 4-1 summarizes the major differences in the toxic modeling between the final MATES III and MATES II analyses. For example, MM5 model meteorological fields, including wind characterization and estimation of vertical diffusion, differ significantly from those created using diagnostic approaches and can greatly alter dispersion patterns throughout the modeling

domain. Changes to emissions estimation assumptions add to the uncertainty of a direct comparison of model simulations.

Table 4-1
Summary Comparison of Key Modeling Considerations Between MATES III and MATES II

Parameter	MATES III and 1998-99 Back-cast	MATES II
Model Platform / Chemistry	CAMx RTRAC	UAMTOX
Meteorology Model /Layers	MM5 Prognostic: 29 layers/CAMx: 8 layers	Diagnostic Wind Model / UAMTOX: 5 layers
Vertical Diffusion	Blackadar PBL to determine grid-layer specific vertical diffusivity	Hourly grid specified mixing height
On-Road Truck Emissions	Caltrans/SCAG Truck Model	Used passenger vehicle pattern
Shipping Emissions Stack Height	Emissions spread through layers 1 and 2	Emissions released in layer 1 (variable size)
Emissions Inventory	2005 Projection from 2002 (2007 AQMP)	1998 Projection from 1997 (2003 AQMP)
Mobile Emissions	EMFAC2007	EMFAC7G

To remedy this problem, this analysis provides a newly-generated set of regional modeling simulations for the MATES II monitoring period using the CAMx – MM5 coupled with the RTRAC chemistry, 1999 back-cast emissions and newly generated 1998-99 meteorological fields to facilitate a direct air quality and risk comparison between MATES II and MATES III. Development of the new simulations follow the same set of assumptions and model applications (where possible) as for the final MATES III analysis.

Three changes to emissions data preparation were implemented in the MATES III modeling. First, emissions from vessels in the shipping lanes were assumed emitted into the first two vertical modeling layers to better estimate plume rise from the hot stack emissions. Combined stack heights and plume rise for typical ocean-going (deep draft) vessels extend above 36 and below 73 meters (WRAP, 2007). MATES II held shipping emissions in the first vertical UAM layer.

Second, the diesel particulate emissions profile for marine vessels and ocean-going vessels using diesel engines was changed to reflect a lower percentage of elemental carbon contribution to the total mass. The initial profile used in the draft MATES III modeling simulations (as well as MATES II analysis) was characteristic of an on-road diesel truck profile where elemental carbon fraction accounted for more than 20% of the particulate mass. The revised analyses used a stationary source large diesel engine profile (which is assumed to be more consistent with the large engines operating on ships) that allocated the elemental carbon fraction at approximately

6% of the total mass of diesel emissions. The total diesel mass emissions from this source category were not impacted by the revision.

The third modification impacted the distribution of truck movement throughout the Basin. At the time of MATES II, no heavy-duty truck movement profile was available to characterize the truck distribution and travel on freeways, arterial and major streets. Truck travel was assigned the travel model characteristics designated for light-duty passenger vehicle travel. MATES III directly incorporated the output of the heavy-duty truck demand model to provide a more realistic characterization of weekday travel. Weekend travel was assigned the same routes but at substantially lowered demand.

4.4 Modeling Results

CAMx RTRAC regional modeling was conducted using MM5 meteorological data and projected emissions data for 2005 to simulate annual average concentrations of 19 key compounds measured as part of the MATES III monitoring program. Simulated annual average concentrations plots for the four toxic compounds that contributed the greatest risk throughout the domain (diesel particulate, benzene, 1,3-butadiene and formaldehyde) are depicted in Figures 4-2 through 4-5.

Figure 4-2 depicts the projected annual average concentration distribution of diesel particulates in the Basin. The highest concentration (10.8 $\mu g/m^3$) was simulated to occur in the grid cells around the Ports of Los Angeles and Long Beach. A secondary maximum occurs in the Central Los Angeles area extending southeast loosely following the Interstate 5 Corridor. In general, the distribution of diesel particulates is aligned with the transportation corridors including freeways, major arterials and rail right-of-ways. Figures 4-3 and 4-4 provide the distributions of benzene and 1,3-butadiene respectively whereby the toxic compounds are almost uniformly distributed throughout the Basin (reflecting patterns of light-duty fuel consumption). The formaldehyde profile shown in Figure 4-5 depicts higher concentrations in the heavily traveled western and central Basin, with additional hot spots in the downwind areas of the Basin that are impacted by higher levels of ozone formation (Santa Clarita and Crestline).

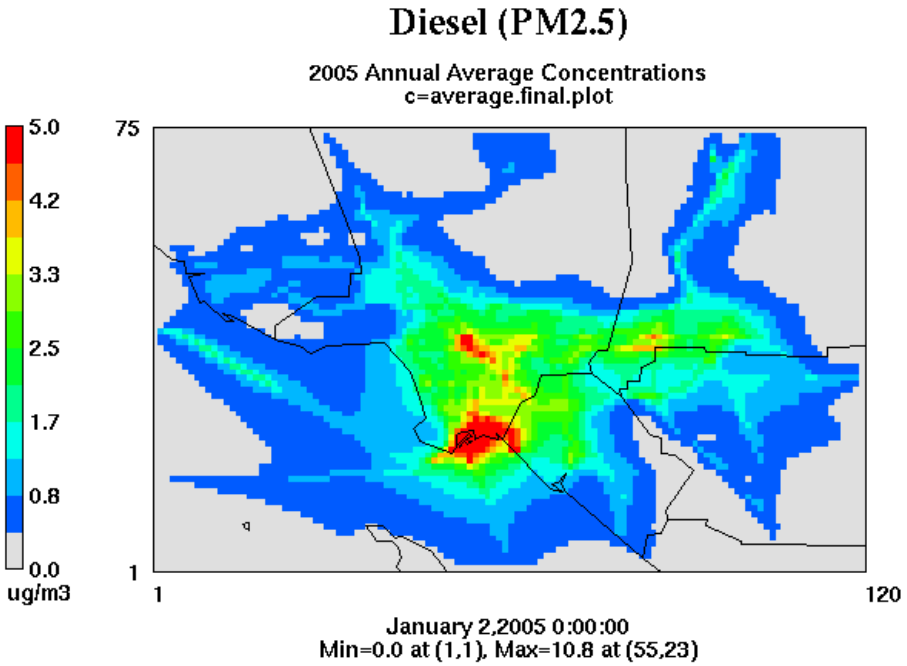

Figure 4-2
Annual Average Concentration Pattern for Diesel $PM_{2.5}$

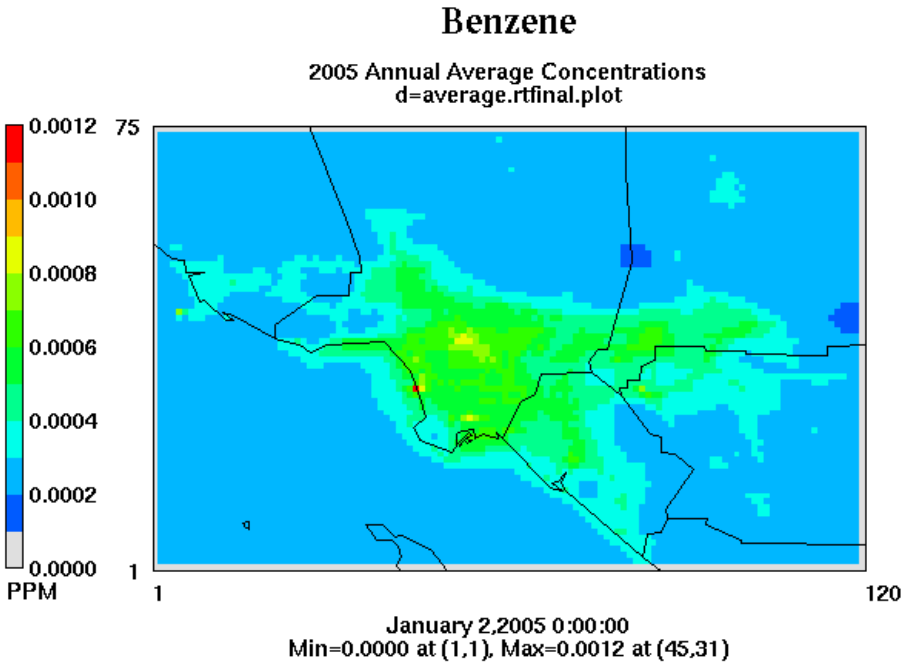

Figure 4-3
Annual Average Concentration Pattern for Benzene

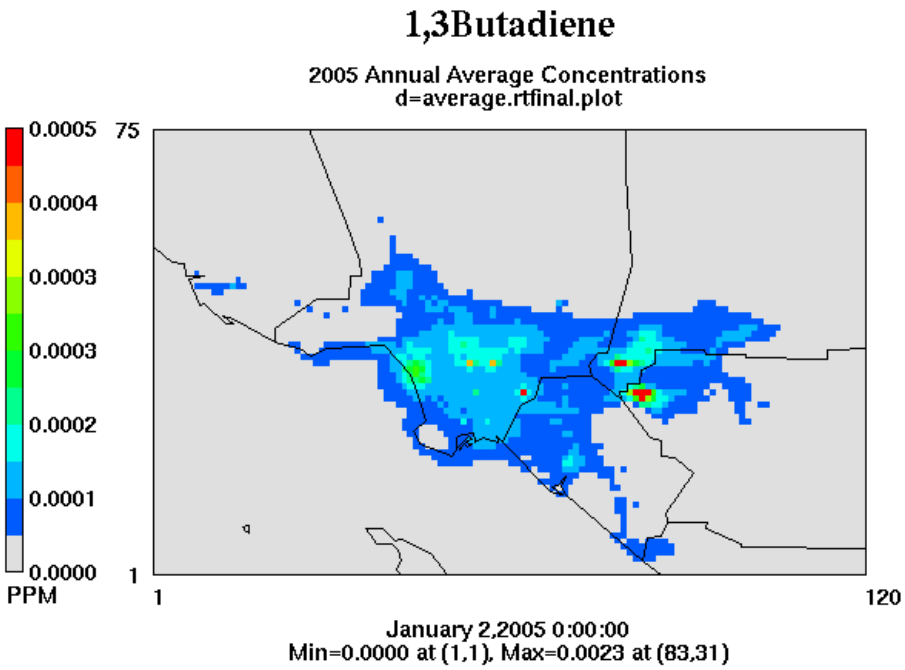

Figure 4-4
Annual Average Concentration Pattern for 1,3-Butadiene

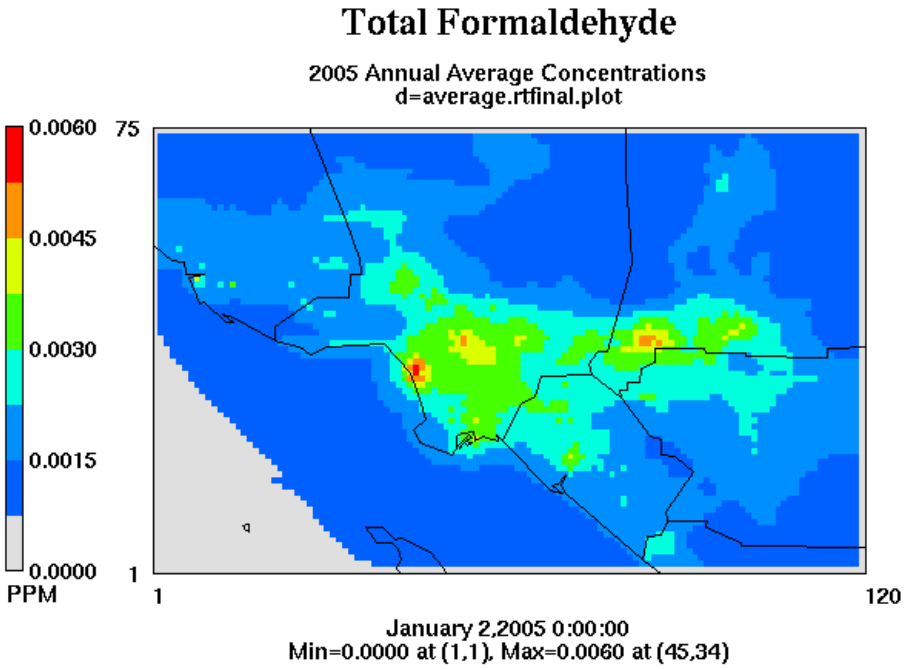

Figure 4-5
Annual Average Concentration Pattern for Total Formaldehyde

Table 4-2 provides a summary of the model performance to recreate measured annual average concentrations. For this comparison, the monitored data for six stations are combined to provide an estimate of average Basin-wide conditions for the two sampling periods: 2005 and 1998-99. Two stations in 2005 (Huntington Park and Pico Rivera) did not have complete measurement records for the full 12 months and were excluded from the analysis. Similarly, complete measurements for Compton and West Long Beach were not available for 1998-99. CAMx RTRAC simulated pollutant concentrations for the six stations that have complete data for the two measurement periods were calculated from the grid data using the distance-weighted nine-cell average. No direct measurements of $PM_{2.5}$ diesel were available for comparison to simulate annual average concentrations. However, estimates of diesel particulate concentrations based on Chemical Mass Balance (CMB) analysis using ambient measured elemental carbon concentrations are discussed later. Measured concentrations of naphthalene were available for West Long Beach, Central Los Angeles, and Rubidoux. Each of the four counties is represented by at least one station. The six stations average measured and simulated concentrations provide an estimate of the regional profile but with a bias toward impacts to the coastal communities in the heavily transited areas of the Basin. Moreover, the assessment provides a direct comparison for model performance evaluation.

Table 4-2
Compounds Simulated and Measured: Six-Station Annual Average Concentrations
2005 MATES III and 1998-99 CAMx RTRAC Analyses

Compound	Units	2005 MATES III		1998-99 MATES II (CAMx RTRAC Simulation)	
		Measured Annual Average	Simulated Annual Average	Measured Annual Average	Simulated Annual Average
$EC_{2.5}$	$\mu g/m^3$	1.78	1.58	N/A	N/A
EC_{10}	$\mu g/m^3$	2.04	2.05	3.01	2.03
Cr 6 (TSP)	ng/m^3	0.22	0.21	0.18	0.17
As (2.5)	ng/m^3	0.5	0.92	N/A	N/A
As (TSP)	ng/m^3	0.68	2.46	1.79	3.00
Cd (2.5)	ng/m^3	1.46	0.49	N/A	N/A
Cd (TSP)	ng/m^3	1.56	0.78	6.57	1.00
Ni (2.5))	ng/m^3	3.93	3.65	N/A	N/A
Ni (TSP)	ng/m^3	4.44	5.82	7.51	6.83
Pb (2.5)	ng/m^3	5.41	2.60	N/A	N/A
Pb (TSP)	ng/m^3	10.64	8.68	22.72	10.00
Benzene	ppb	0.53	0.52	0.97	0.75
Perchloroethylene	ppb	0.06	0.09	0.27	0.18
p-Dichlorobenzene	ppb	0.03	0.08	0.12	0.06
Methylene Chloride	ppb	0.35	0.32	0.70	0.54
Trichloroethylene	ppb	0.03	0.03	0.10	0.05
1,3-Butadiene	ppb	0.1	0.09	0.29	0.13
Formaldehyde	ppb	3.61	3.26	4.00	3.75
Acetaldehyde	ppb	1.64	1.12	1.81	1.26
Naphthalene	ppb	0.02*	0.01	N/A	0.02

* Three station average

In general, 2005 model simulated particulate $EC_{2.5}$, EC_{10}, hexavalent chromium and $PM_{2.5}$ nickel average annual toxic compound concentrations compared well with the measured annual average values. The majority of gaseous components were well-simulated with the sole exception of acetaldehyde which is underpredicted. Arsenic and TSP lead exhibit the greatest tendency for overprediction. Cadmium and $PM_{2.5}$ lead concentrations tend to be underpredicted. In general, the concentrations of the gaseous compounds are closely recreated.

For 1998-99, there exists a general tendency for underprediction. Hexavalent chromium and nickel average annual toxic compound concentrations are exceptions that are closely matched to observations. Aside from the uncertainties associated with the modeling analyses, some uncertainty in prediction accuracy is introduced into the analysis through the measurement and analysis programs. The 1998-99 data samples were measured and analyzed by different agencies (AQMD and ARB) and their laboratories. In addition, the substitution of one-half level of detection for data measured below the detection limit also adds to the uncertainty in the analysis.

Simulated annual average $EC_{2.5}$ was the compound used to assess overall model performance for the 2005 MATES III period at the eight sites having a full year's sampling. The analysis used annual average $EC_{2.5}$ model performance to provide consistency with the 2007 AQMP annual average $PM_{2.5}$ attainment demonstration modeling assessment. While the 2007 $EC_{2.5}$ AQMP modeling was conducted on a coarser grid (5 kilometer squared), it was expected that the summary performance of the CAMx RTRAC 2005 MATES III simulation should be consistent but not identical. Table 4-3 summarizes the 2005 MATES III $EC_{2.5}$ model performance.

EPA guidance (U.S. EPA, 2006) recommends evaluating particulate modeling performance using measures of prediction bias and error. An additional useful tool is prediction accuracy (PA) measured as the percentage difference between the mean annual observed and simulated $EC_{2.5}$ concentrations. PA goals of ±20% for ozone and ±30% for individual components of $PM_{2.5}$ or PM_{10} have been used to assess simulation performance in previous modeling attainment demonstrations. PA at seven of the eight MATES III sites meet the $PM_{2.5}$ goal, with only Burbank exhibiting a large degree (50%) of underprediction of the annual average concentration. Of the remaining sites, Inland Valley San Bernardino and Rubidoux are underpredicted by 19 and 22%, respectively, and North Long Beach is overpredicted by 22%. All other sites PA falls within ±10 % of observations.

Analysis of the poor performance at Burbank revolves around the inability of the meteorological model to exactly recreate observed winds in an area of complex terrain where the winds are required to bifurcate and reverse directions in a short distance. Winds from the southeast transport mobile source emissions from the 101 Freeway, Interstate 5, and a major leg of the north and southbound commuter and cargo rail systems directly at the Burbank air monitoring site. While the MM5 wind fields do an admirable job of turning the sea breeze northward in the immediate Burbank area, the simulated resultant flow is from the south and only captures a portion of the mobile source impact. In addition, the upwind grid cells adjacent to the south of the Burbank grid include the wild land open space of Griffith Park where emissions are limited. (A detailed discussion of model performance is presented in Appendix IX).

Table 4-3
MATES III 2005 $EC_{2.5}$ Model Performance

Location	$EC_{2.5}$ Observed ($\mu g/m^3$)	Modeled Observed Days ($\mu g/m^3$)	Prediction Accuracy	Mean Bias ($\mu g/m^3$)	Mean Error ($\mu g/m^3$)	Normalized Mean Bias ($\mu g/m^3$)	Normalized Mean Error ($\mu g/m^3$)
Anaheim	1.41	1.35	-4	-0.06	0.54	0.39	0.61
Burbank	2.04	1.03	-50	-1.02	1.11	-0.31	0.48
Compton	1.76	1.88	7	0.12	0.61	0.39	0.52
Inland Valley San Bernardino.	2.18	1.77	-19	-0.41	0.91	0.09	0.56
Long Beach	1.40	1.71	21	0.30	0.61	0.54	0.64
Central L.A.	1.93	2.04	6	0.11	0.76	0.39	0.58
Rubidoux	1.69	1.32	-22	-0.38	0.74	0.09	0.58
West Long Beach	2.07	2.14	3	0.07	0.79	0.33	0.53
All Stations	1.86	1.70	-9	-0.17	0.77	0.23	0.54

4.5 Estimation of Risk

Figure 4-6 depicts the distribution of risk estimated from the predicted annual average concentrations of the key toxic compounds. Risk is calculated for each grid cell as follows:

$$\text{Risk}_{i,j} = \Sigma \ \text{Concentration}_{i,j,k} \ X \ \text{Risk Factor}_{i,j,k}$$

Where $_{i,j}$ is the grid cell (easting, northing) and k is the toxic compound.

The grid cell having the maximum simulated risk of 3,693 was located in the Ports of Los Angeles and Long Beach. More specifically, the grids having the top 25 estimated risk values in 2005 were located in cells around the ports area. The cell having the highest risk outside of the port area occurred in South Los Angeles as part of a cluster of grids that extended from Central Los Angeles to the southeast following Interstate-5. Other elevated areas included the eastern Basin near the communities of Colton, Inland Valley San Bernardino, and San Bernardino. As with the MATES II analysis, areas projected to have higher risk followed transportation corridors, including freeways and railways.

Figure 4-7 provides the CAMx RTRAC simulated air toxics risk for the 1998-99 period (using back-cast 1998 emissions and 1998-99 MM5 generated meteorological data fields). Figure 4-8 depicts the 1998-99 to 2005 change in risk estimated from the CAMx RTRAC simulations. The greatest increase in risk occurred in the port area. Overall, air toxics risk improves to varying levels in most of the Basin with the exceptions of the areas directly downwind of the Ports and those areas heavily impacted by activities associated with goods movement. Risk increases of more than 800 in a million between the two periods were noted in the immediate areas encompassing the ports.

The 2005 Basin average population-weighted risk summed for the toxic components yielded a cancer risk of 853 in a million. (The Basin average risk included all populated over land cells

that reside within the Basin portion of the modeling domain). The MATES II Basin average risk was 981 per million as determined from the UAMTOX modeling analysis. However, when Basin population-weighted average risk is recalculated for the 1998-99 MATES II period using CAMx RTRAC modeling platform the comparable Basin average risk is 931 per million. A direct comparison of Basin risk calculated using the CAMx RTRAC simulations between MATES II and MATES III shows an 8% reduction. The 8% reduction in Basin risk can be attributed to several factors, most notably changes in emissions and spatial allocation between 1998 and 2005. While weather profiles between the two monitoring periods varied, no appreciable difference was observed in the meteorological dispersion potential.

Regional risk from non-diesel sources (Figure 4-9) is also uniformly distributed throughout the Basin with values typically ranging from 100 to 300 in one million. Several elevated grid cells are apparent with risk estimated upwards of 400 in one million in the coastal plain encompassing Los Angeles International Airport and the heavily industrialized areas south of Downtown Los Angeles. Selected elevated grid cells are also evident in the east Basin with values of up to 1,000 in one million.

Figure 4-10 provides a focused 2005 estimated air toxics risk in the Ports area. Table 4-4 provides a summary risk estimated for the Basin, for the Ports area, and for the Basin excluding the Ports area. For this assessment, the Ports area includes the populated cells roughly bounded by the Interstate 405 to the north, San Pedro to the west, Balboa Harbor to the east and Pt. Fermin to the south. The 2005 average population-weighted air toxics risk in the Ports area (as defined above) was 1,415 in one million. The Basin average population-weighted air toxics risk, excluding the grid cells in the Ports area, valued 816 in one million. (It is important to note that the downwind impacts resulting from Port area activities are reflected in the toxics risk estimates for the grid cells categorized as “Basin minus Ports”). A similar calculation based on the CAMx RTRAC simulations for 1998-99 indicated that the Ports area air toxics risk was 1,208; and the Basin, minus the Ports area, was 912 in one million. Overall, the Ports area experienced an approximate 17% increase in risk, while the average population-weighted risk in other areas of the Basin decreased by about 11%.

As a sensitivity analysis, simulations were generated to examine the hypothesis “what would the Basin toxics risk profile in 2005 be if no growth occurred in the goods movement sector from 1998?” To attempt to answer this question, heavy-duty truck transport, shipping, port and rail operation activity levels associated with goods movement were held at 1998 levels. The impacts of fleet turnover and control measure implementation were allowed to go forward through 2005 to develop the hypothetical emissions inventory. The results of the sensitivity test indicated that the Ports area, Basin, and Basin excluding the ports areas would experience lower toxic risk levels by 6.2%, 14.8%, and 15.46% respectively.

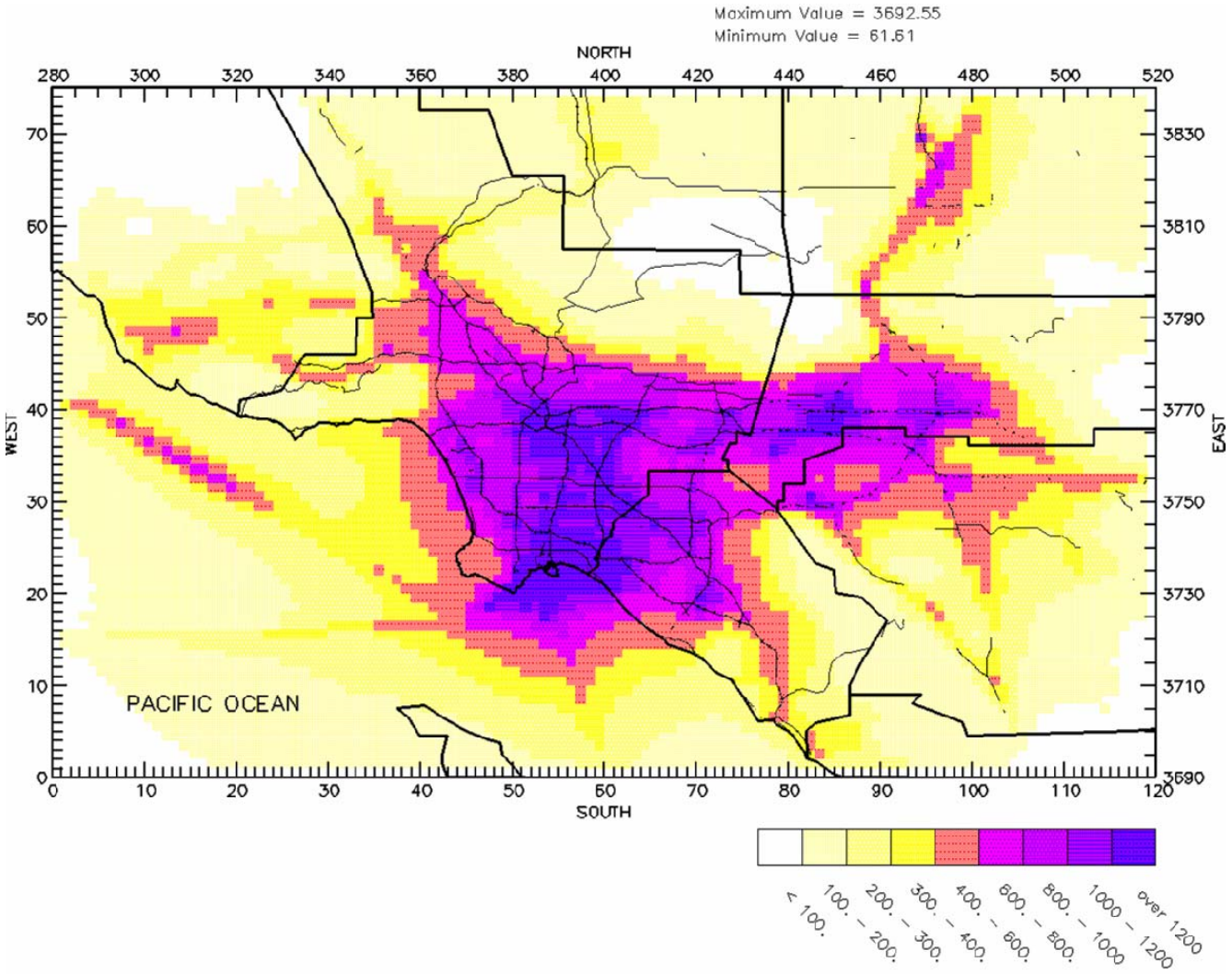

Figure 4-6
2005 MATES III CAMx RTRAC Simulated Air Toxic Risk

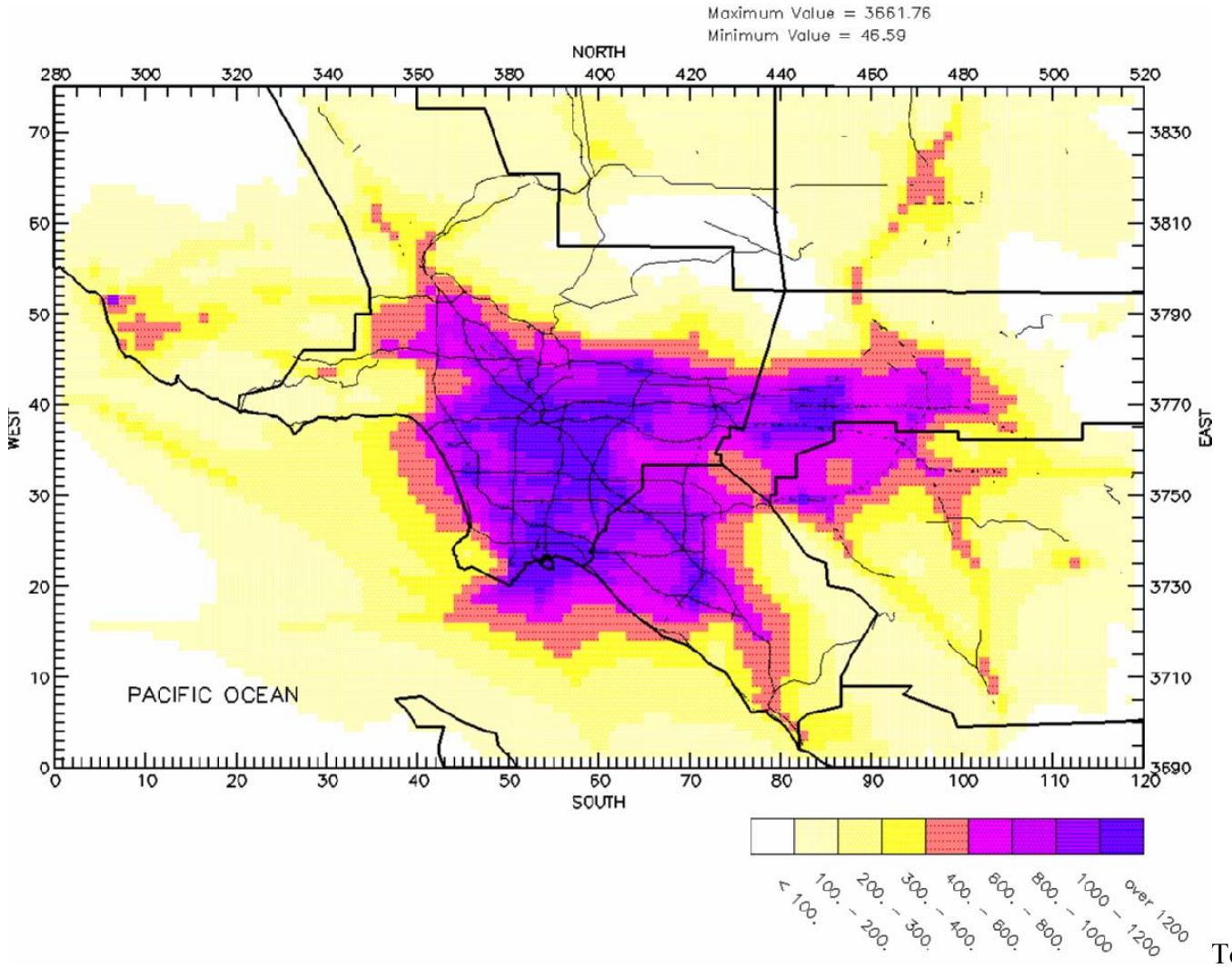

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Figure 4-7
1998-99 MATES II CAMx RTRAC Simulated Air Toxic Risk

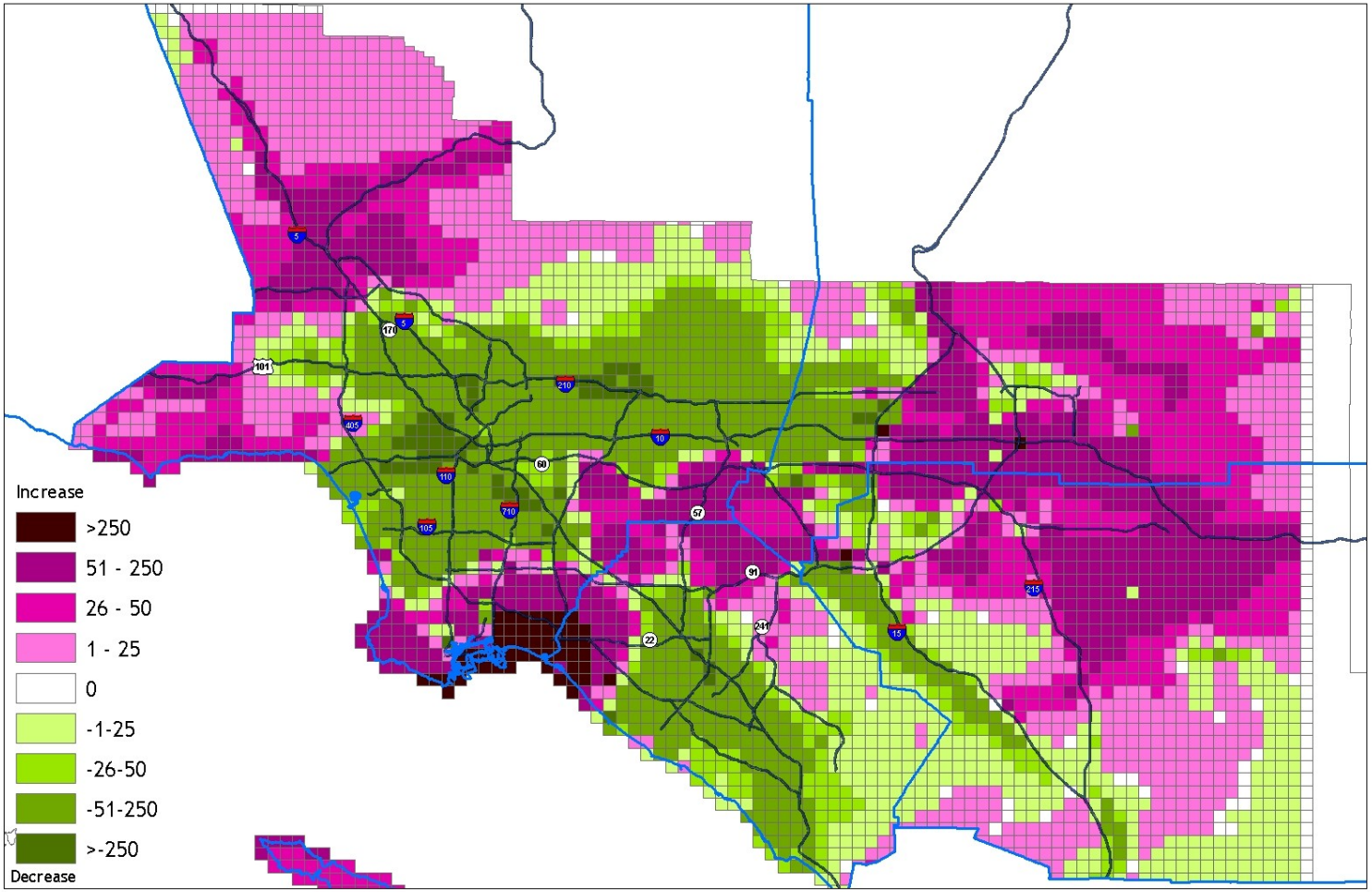

Figure 4-8
Change in CAMx RTRAC Simulated Air Toxics Risk (per million) from the 1998-99 to 2005 (using back-cast 1998 emissions and 1998-99 MM5 generated meteorological data fields)

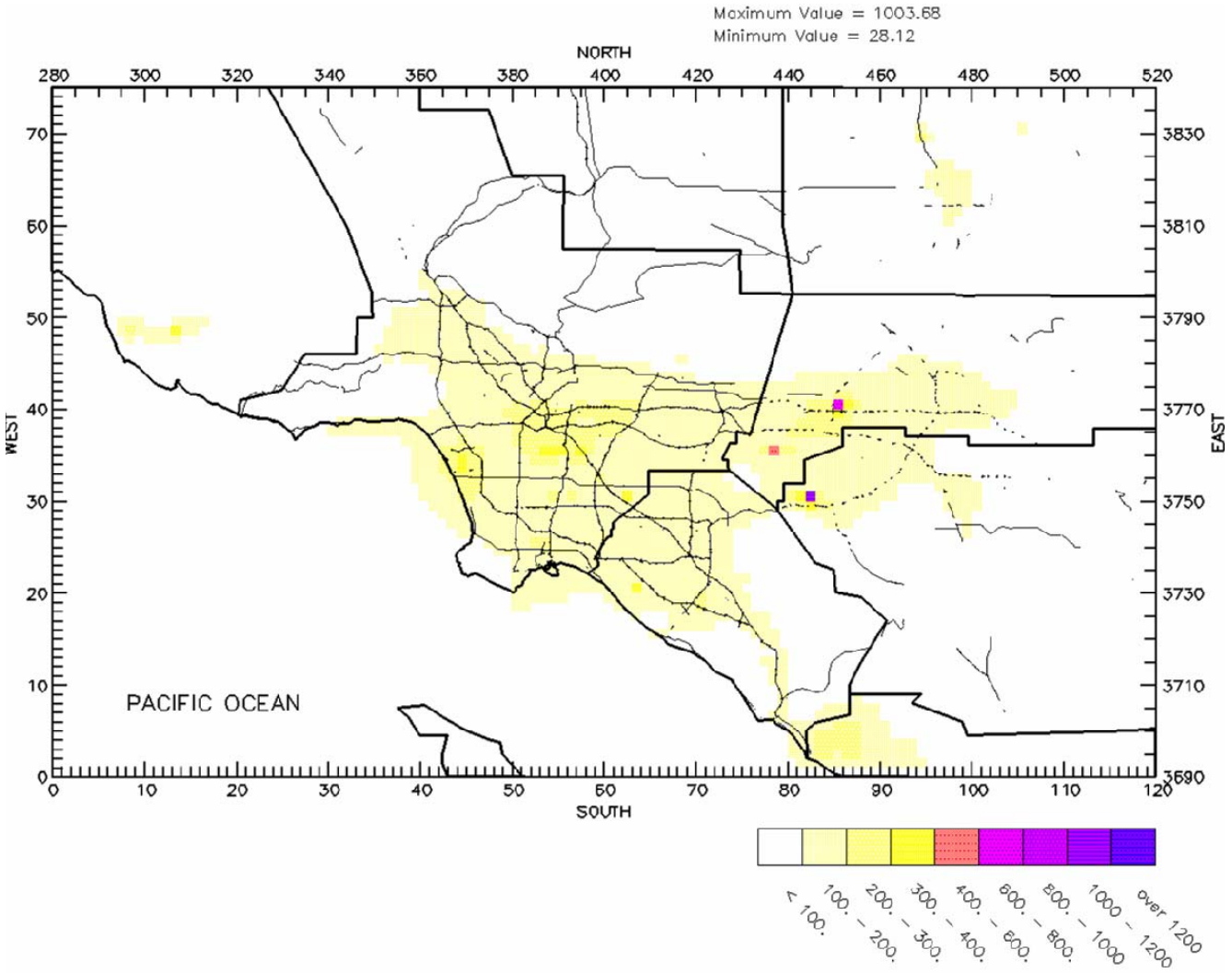

Figure 4-9
MATES III 2005 Simulated Air Toxic Risk-No Diesel

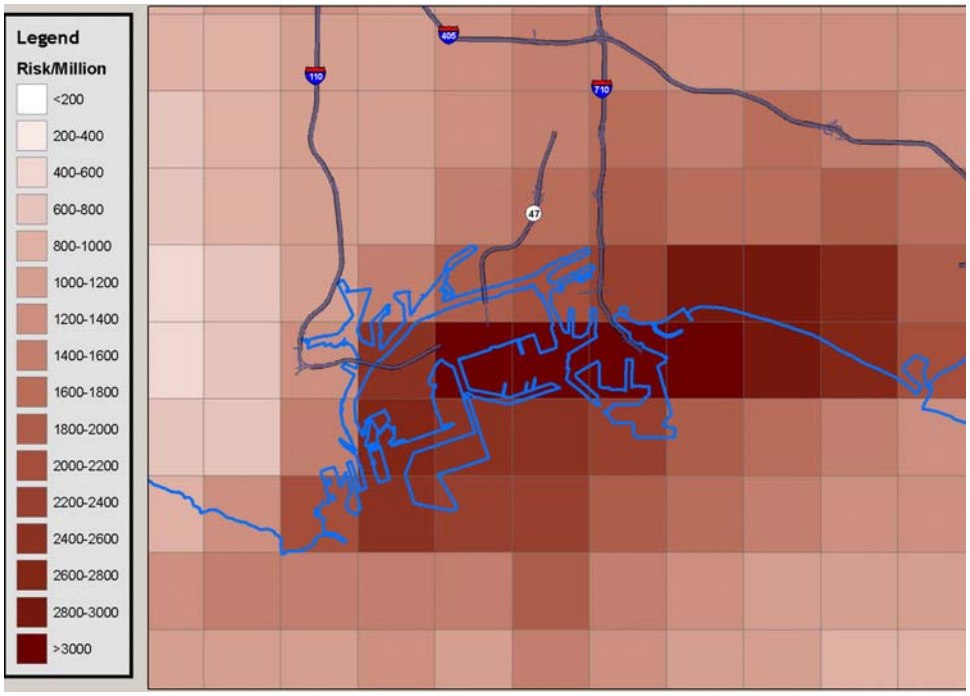

Figure 4-10
2005 Ports Area MATES III Simulated Air Toxic Risk

Table 4-4
Basin and Port Area Population-Weighted Risk

Region	MATES III		MATES II*		Average Percentage Change in Risk
	2005 Population	Average Risk (Per Million)	1998 Population	Average Risk (Per Million)	
Basin	15,662,620	853	14,404,993	931	-8
Ports Area	959,761	1,415	911,834	1207	17
Basin Excluding Ports Area	14,702,859	816	13,493,159	912	-11

* CAMx RTRAC Simulations

Figures 4-11 through 4-14 provide close-up depictions of risk to Central Los Angeles, Mira Loma, Colton, Central Orange County, and West Los Angeles areas, respectively.

Table 4-5 provides the county breakdown of air toxics risk to the affected population. As presented in the spatial distribution, Los Angeles County bears the greatest average risk at 951 per one million person population. Orange County has the second highest number of projected risk at 781 per one million person population. Risk in the Eastern Basin is lower. The estimated risk for San Bernardino is 712 per million, and Riverside was estimated to have the lowest population-weighted risk at 485. It should be noted that these are county-wide averages, and individual communities could have higher risks than the average if they are near emissions sources, such as railyards or intermodal facilities.

Comparison of the county-wide population-weighted risk shows that the greatest reduction occurred in Los Angeles County. Reductions in emissions from mobile sources including benzene, 1,3-butadiene, and diesel particulate have contributed to the improved county-wide risk. A similar profile is evident in Orange County. Despite across-the-board improvements in measured toxic air quality from MATES II (with the sole exception of hexavalent chromium at Rubidoux), population growth in the east Basin and associated increases in mobile source emissions has resulted in a nominal increase in population-weighted risk for Riverside County. Similarly, San Bernardino County risk levels improved only marginally.

Table 4-5
County-Wide Population-Weighted Risk

Region	MATES III		MATES II*		Average Percentage Change in Risk
	2005 Population	Average Risk (Per Million)	1998 Population	Average Risk (Per Million)	
Los Angeles	9,887,127	951	9,305,726	1,047	-9
Orange	2,764,620	781	2,579,794	833	-6
Riverside	1,548,031	485	1,249,554	478	2
San Bernardino	1,462,842	712	1,269,919	725	-2
SCAB	15,662,620	853	14,404,993	931	-8

* CAMx RTRAC Simulations

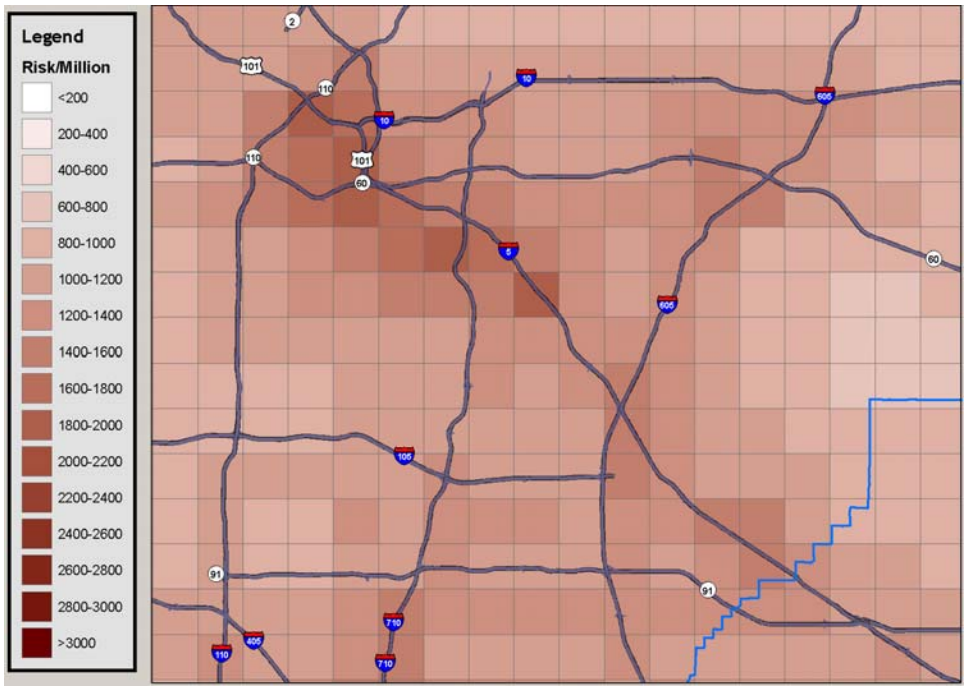

Figure 4-11
2005 Central Los Angeles MATES III Simulated Air Toxic Risk

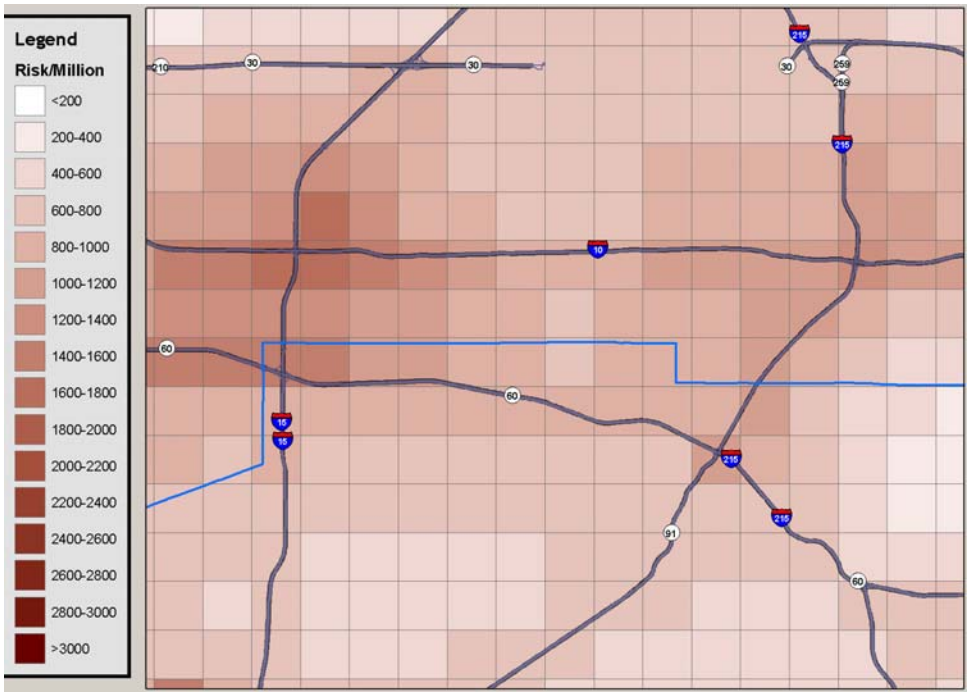

Figure 4-12
2005 Mira Loma/Colton MATES III Simulated Air Toxic Risk

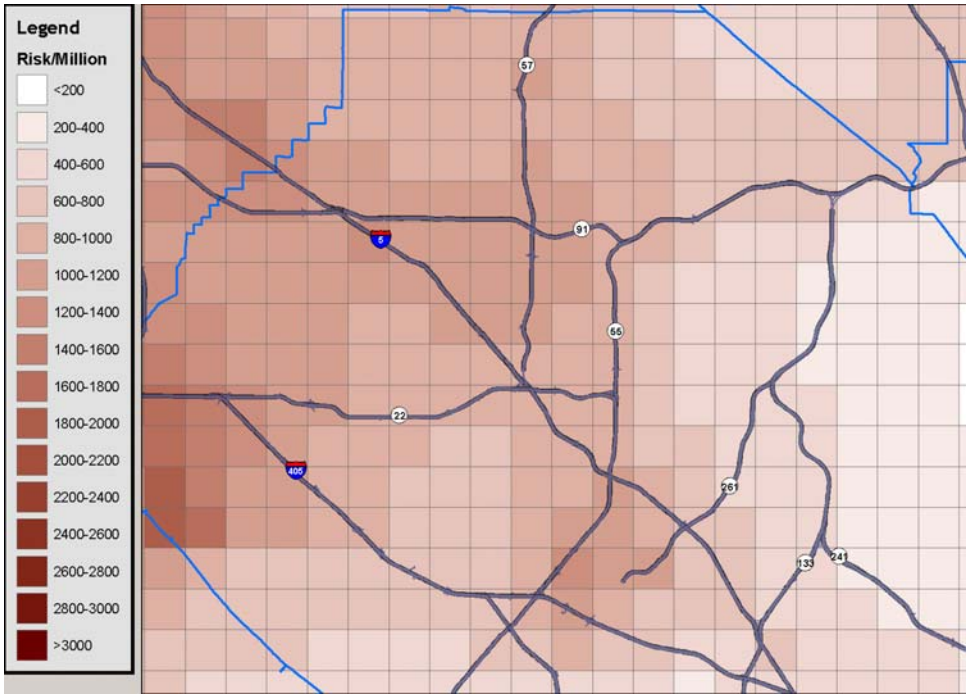

Figure 4-13
2005 Central Orange County MATES III Simulated Air Toxic Risk

Figure 4-14
2005 West Los Angeles MATES III Simulated Air Toxic Risk

Table 4-6 provides the Basin average breakdown of risk associated with each of the key compounds simulated in the analysis. Diesel particulate ranked highest as the toxic compound contributing to the overall risk from air toxics to the population. The next three highest contributors included benzene, 1,3-butadiene and hexavalent chromium.

Table 4-6
2005 MATES III Risk from Simulated Individual Toxic Air Contaminants

Toxic Compound	Risk Factor ($\mu g/m^3$)	Peak Annual Average Concentration	Population Weighted Annual Average Concentration	Units	Cumulative Risk (per million)	% Contribution
Diesel	3.00E-04	11.70	2.35	$\mu g/m^3$	703.76	82.5
Benzene	2.90E-05	1.15	0.48	ppb	44.53	5.2
1,3- Butadiene	1.70E-04	2.32	0.081	ppb	30.45	3.6
Hexavalent Chromium 6	1.50E-01	0.003	0.00016	$\mu g/m^3$	23.41	2.7
Primary Formaldehyde	6.00E-06	4.89	1.60	ppb	11.78	1.4
Secondary Formaldehyde	6.00E-06	1.60	1.30	ppb	9.61	1.1
Arsenic	3.30E-03	0.022	0.0024	$\mu g/m^3$	7.97	0.9
p-Dichlorobenzene	1.10E-05	0.208	0.076	ppb	5.01	0.6
Secondary Acetaldehyde	2.70E-06	0.766	0.67	ppb	3.25	0.4
Perchloroethylene	5.90E-06	0.370	0.92	ppb	3.67	0.4
Napthalene	3.40E-05	0.046	0.017	ppb	3.10	0.4
Cadmium	4.20E-03	0.009	0.00054	$\mu g/m^3$	2.28	0.2
Primary Acetaldehyde	2.70E-06	0.917	0.35	ppb	1.72	0.2
Methylene Chloride	1.00E-06	1.062	0.29	ppb	1.02	0.1
Nickel	2.60E-04	0.298	0.0035	$\mu g/m^3$	0.90	0.1
Trichloroethylene	2.00E-06	0.340	0.029	ppb	0.31	< 0.1
Lead	1.20E-05	0.104	0.0075	$\mu g/m^3$	0.09	<0.1

Table 4-7 provides the simulated air toxics risk at each of the eight stations (evaluated in Table 4-2) for the three main toxic compounds and the remaining aggregate based on the regional modeling. Risk is calculated using the predicted concentrations of each toxic component for the specific monitoring station location (based on a nine-cell weighted average concentration). The summary also provides the comparison between simulated average risk for the eight stations

combined and the average risk calculated using the annual toxic compound measurements and the estimated diesel concentrations at those sites.

Table 4-7
Comparison of Network Averaged CAMx RTRAC 2005 Modeled Risk to Measured Risk at the Eight MATES III Sites

Location	2005 MATES III CAMX RTRAC Simulation				
	Benzene	1,3-Butadiene	Others	Diesel	Total
Anaheim	47	31	75	900	1,054
Burbank	44	25	64	613	746
Compton	52	54	94	950	1,150
Inland Valley San Bernardino	41	25	121	734	922
North Long Beach	53	36	84	1,282	1,455
Central Los Angeles	64	47	115	1,256	1,482
Rubidoux	42	33	70	700	845
West Long Beach	55	30	86	1,501	1,672
8-Station Average Modeled	50	35	89	992	1,166
8-Station MATES III Average Measured ($EC_{2.5}$ * 1.95 for Diesel)	53	34	83	1,070	1,240
8-Station Average Measured (with range of CMB Diesel risk)	53	34	83	1,004 – 1,120	1,174 – 1,290
8-Station Average Measured (average of CMB Diesel risk)	53	34	83	1,062	1,232

The highest simulated risk was estimated for West Long Beach followed by Los Angeles, North Long Beach, and Compton. The lowest modeled risk was simulated at Burbank. As previously discussed, simulation performance at Burbank showed a tendency for underprediction; and this feature appears to be translated to the risk calculation.

The non-diesel portion of the simulated risk can be directly compared to risk calculated from the toxic compound measurements. Figure 4-15 presents a comparison of the model simulated and measurement estimated non-diesel risk at each monitoring site, as well as the eight-station average. Simulated non-diesel risk is within 30% of measurements at all stations with the sole exception of Burbank. In general, there appears to be no geographical bias in model performance, and the simulated eight-station average risk is essentially equal to the risk estimated from the measurements.

Simulated total risk includes the contribution of diesel particulates and, taken as an eight-station average, the modeled risk 1,166 in a million. The eight-station average simulated risk is approximately 6% lower than the risk calculated from the measured toxic compound concentrations and the estimates of diesel concentrations using the emissions based factor (1.95) applied to the $EC_{2.5}$ average concentration. When the model simulated risk is compared to the measurement calculated risk, including the range of CMB estimated diesel concentrations, the

eight-station average risk was nominally less than the lower projection of the range based on measurement data. The eight-station simulated risk based on the CAMx RTRAC analyses was approximately 10% lower than the average of the CMB estimated diesel risk based on the two source profiles.

4.6 Evaluation

The population-weighted average Basin air toxics risk (853 per million) simulated using CAMx RTRAC for the 2005 MATES III period was estimated to be 8% lower than estimated (931 in a million) for 1998-99 when the same modeling platforms and year specific meteorology are evaluated. This is loosely compared to a 17% reduction in average population-weighted risk (981) estimated for the 1998-99 MATES II analysis using the UAMTOX modeling platform. The areas of the Basin having maximum risk continued to be the Ports of Los Angeles and Long Beach with a secondary maximum occurring in an area starting in South Los Angeles and extending toward southeastern Los Angeles.

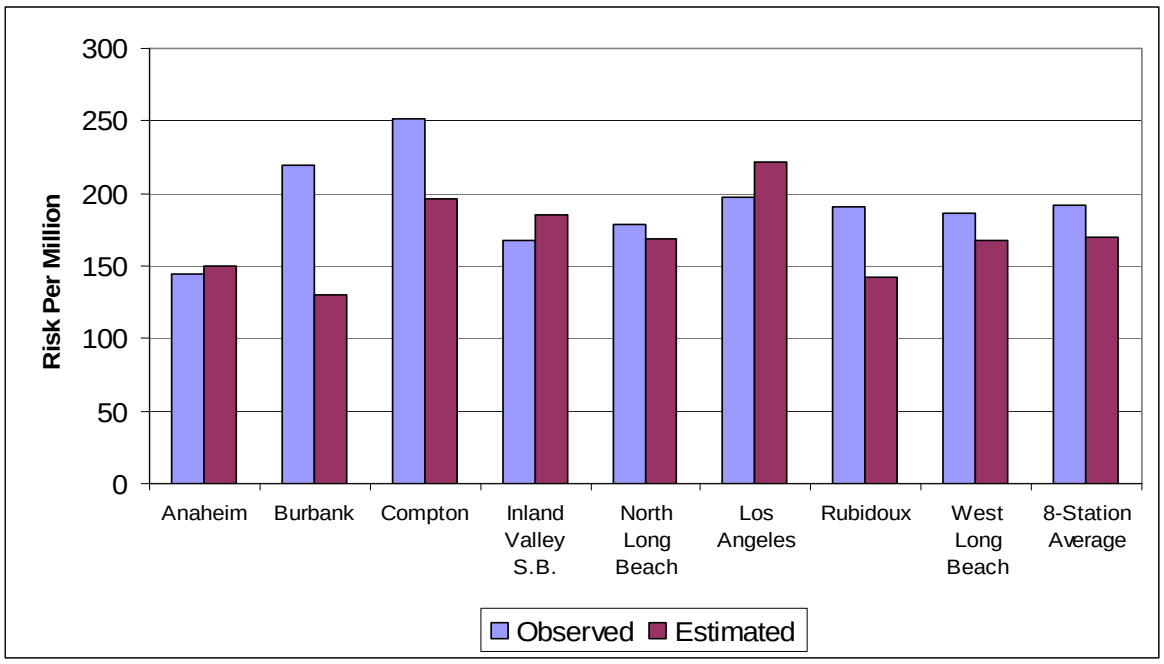

Figure 4-15
2005 MATES III Simulated vs. Measured Concentrations for Non-Diesel Air Toxics Risk

The average simulated Basin air toxics risk for the 2005 MATES III data is 8% lower than the comparable average risk estimated for the 1998 MATES II analysis. Using the 2007 AQMP inventory back-cast methodology, the percentage reduction in diesel mass emissions from 1998 to 2005 is approximately 5%. However, emissions reductions of benzene (36%), 1,3-butadiene (31%), arsenic (20%) and hexavalent chromium (85%) contribute greatly to the overall reduction in 2005 simulated risk. A general assessment of the observed meteorological profile suggests that the two monitoring periods were comparable in dispersion potential.

4.7 References

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