Multiple Air Toxics Exposure Study (MATES) III

SCAQMD

MATES III Technical Advisory Group

August 12, 2008

July 2008 Revisions to Draft

- Introduction
  - Risk estimates discussion added
- Monitoring
  - Hexavalent chromium
  - Data reporting and non detects
- Emissions Inventory
  - Updated ship emissions
  - Updated hexavalent chromium emissions
- Modeling
  - Additional sensitivity analyses – mixing parameters
  - Improved model performance
  - Applied MATES III methods to 1998-99 (MATES II)
- CMB
  - Seasonal analysis added
  - Additional descriptions of source profiles
- Weekend/Weekday – Appendix X added

Comments

- Risk estimates
  - Additional perspective/context
  - Uncertainties in potency estimates for carcinogens
  - More discussion on cancer risk assessment process and uncertainties
  - Additional discussion on other causes of cancer – not all due to air exposures – put air toxics risks in perspective
  - ✓ Included additional discussion in Introduction
  - Used inappropriate risk factors
  - Include adjustment to account for people moving about during day and spending time indoors
  - ✓Used Cal/EPA risk factors
  - ✓Did not include adjustments

Hexavalent Chromium

- Increased levels observed at Rubidoux

✓ Follow-up measurements point to TXI facility as source

✓ Monitoring study data presented to Board

✓ Updates of ongoing measurements posted on AQMD web site

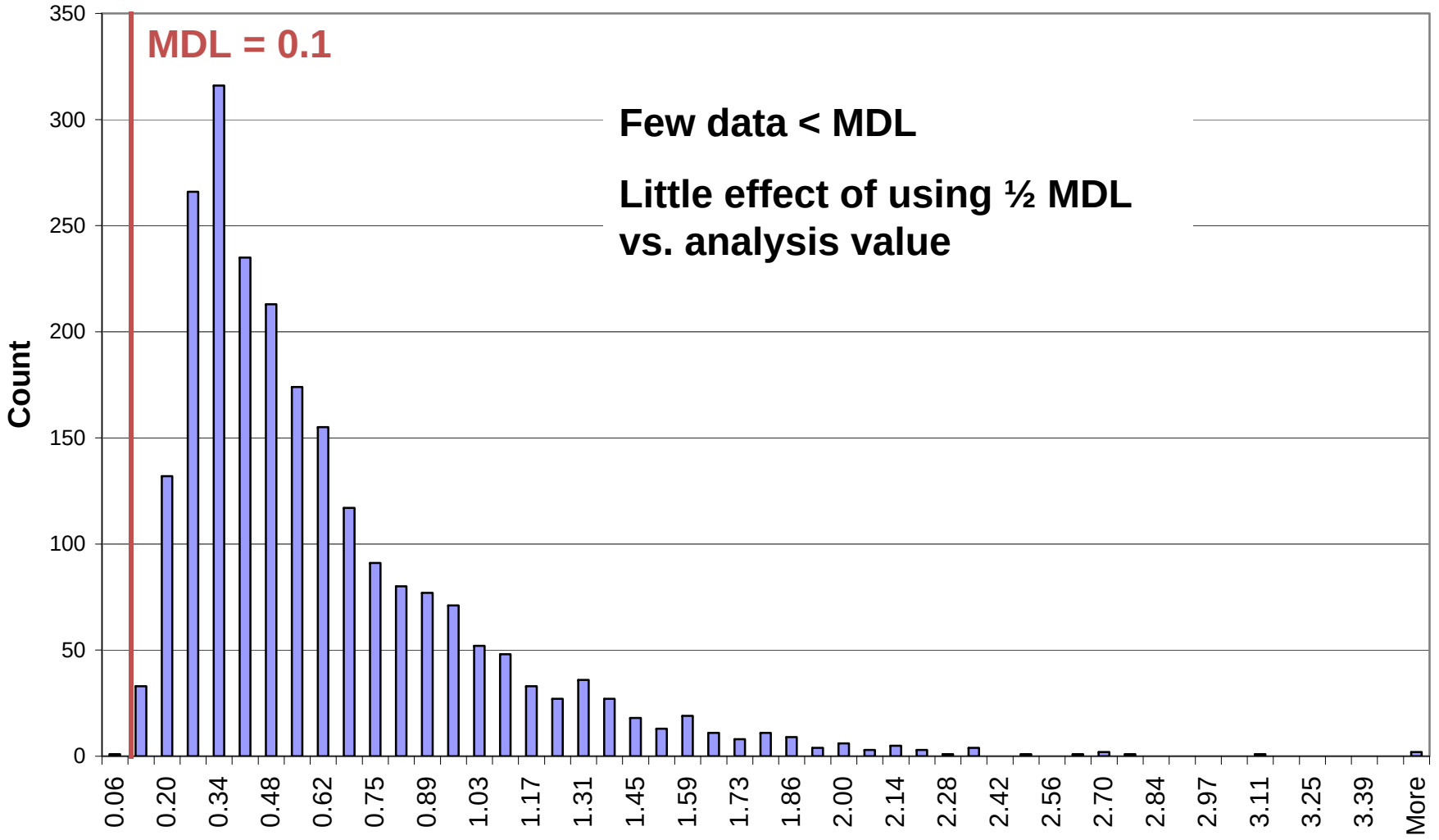
✓ http://www.aqmd.gov/RiversideCement/RiversideCement.html

Comments (cont.)

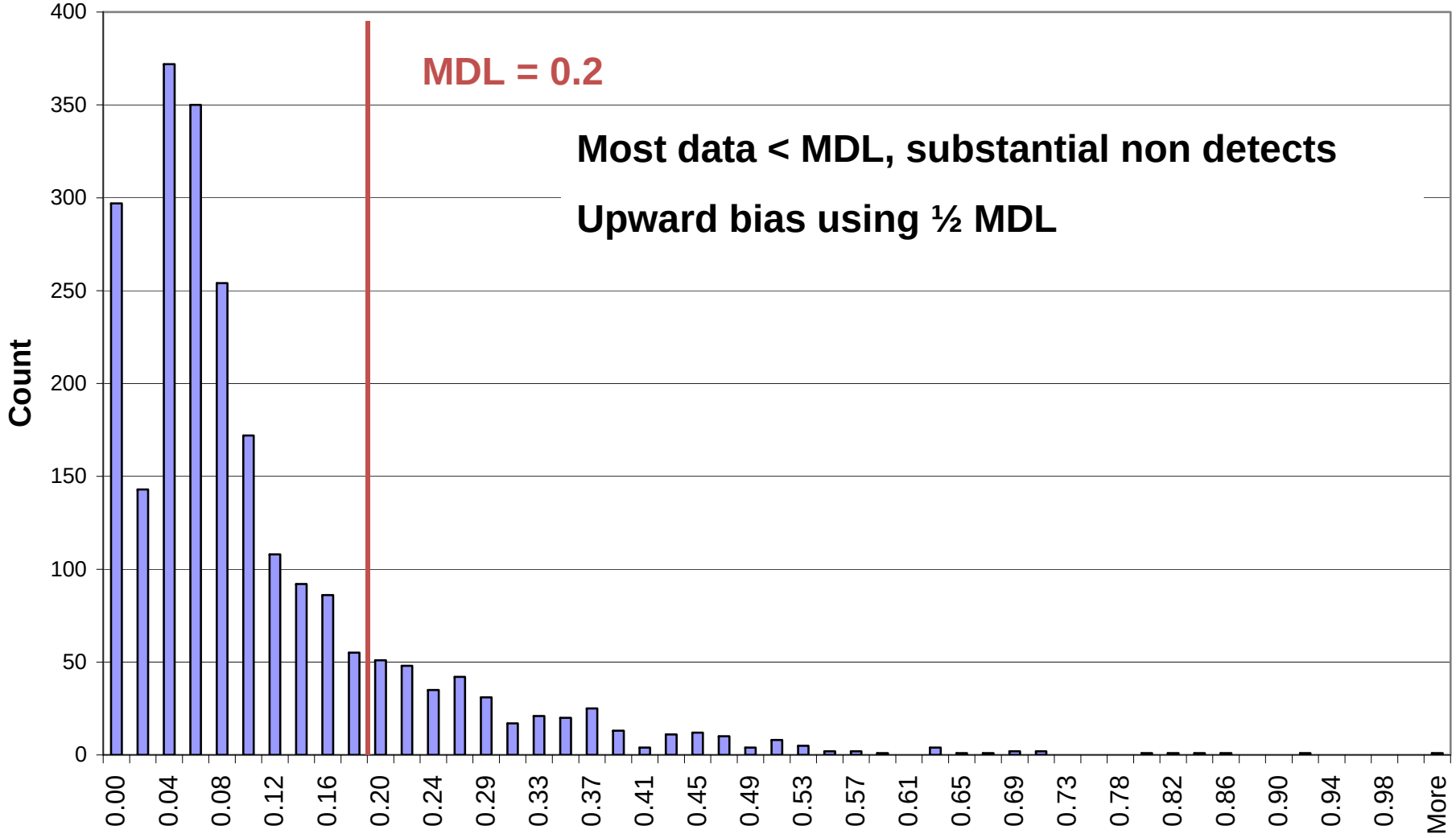
- Effects of data reporting conventions on results
  - Using actual analysis output for analyses below the Method Detection Limit rather than ½ MDL
  - Using zero for non-detects
  - Not consistent with previous studies
  - Treating metals differently than other analytes

  ✓ Additional charts and discussion on effects of data reporting convention

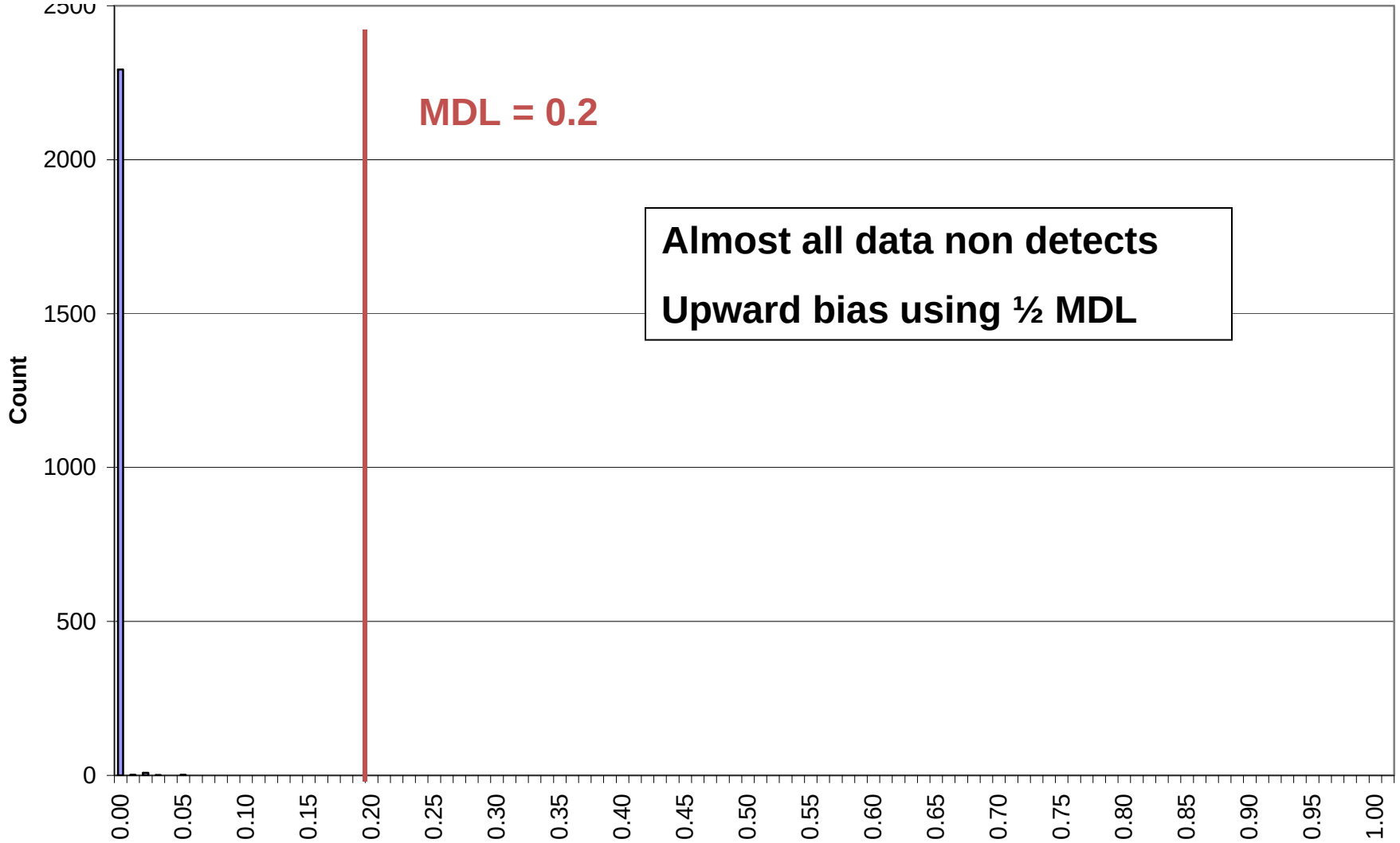
Benzene

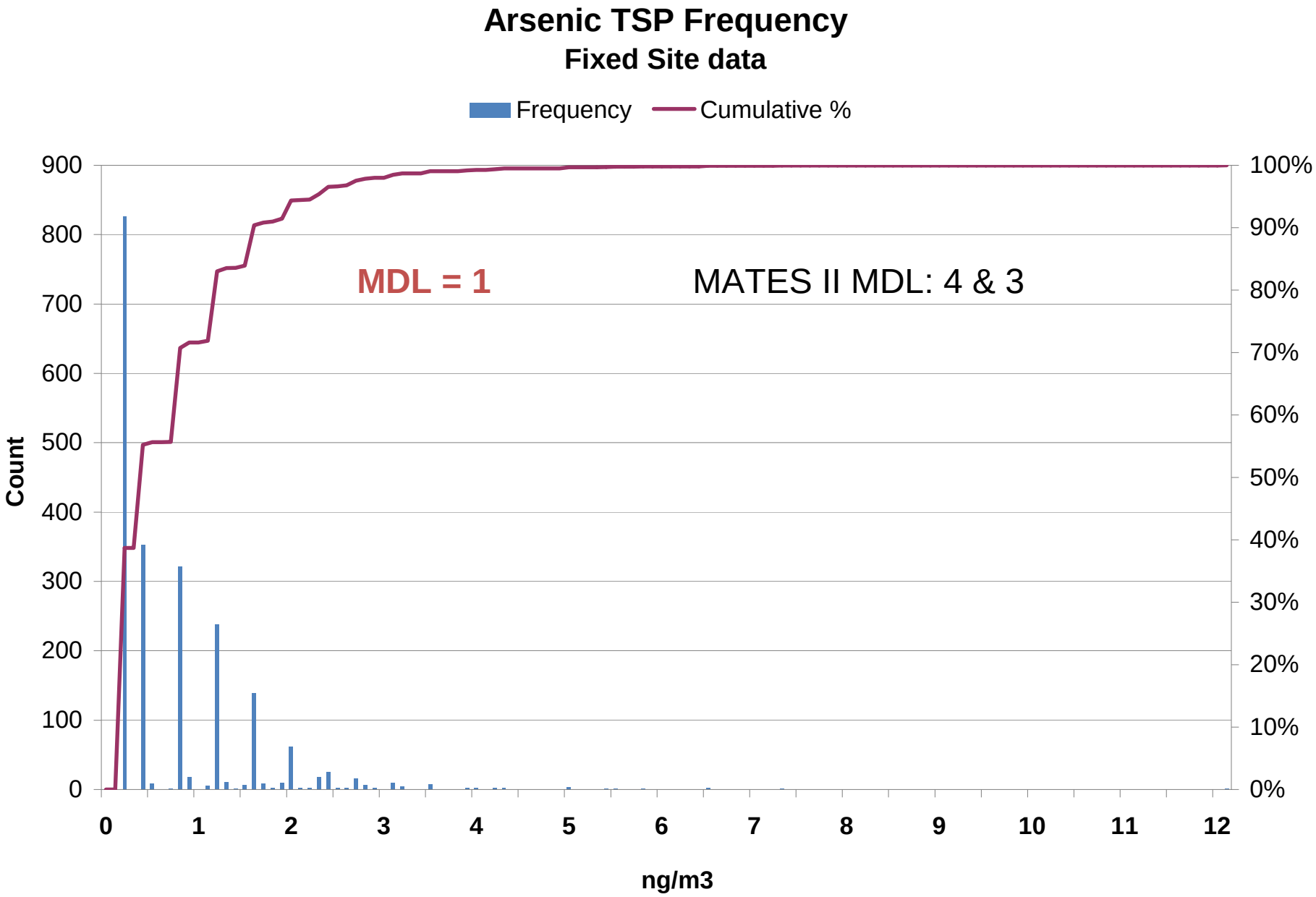

MDL = 0.1
Few data < MDL
Little effect of using ½ MDL vs. analysis value
Count
350
300
250
200
150
100
50
0
0.06
0.20
0.34
0.48
0.62
0.75
0.89
1.03
1.17
1.31
1.45
1.59
1.73
1.86
2.00
2.14
2.28
2.42
2.56
2.70
2.84
2.97
3.11
3.25
3.39
More

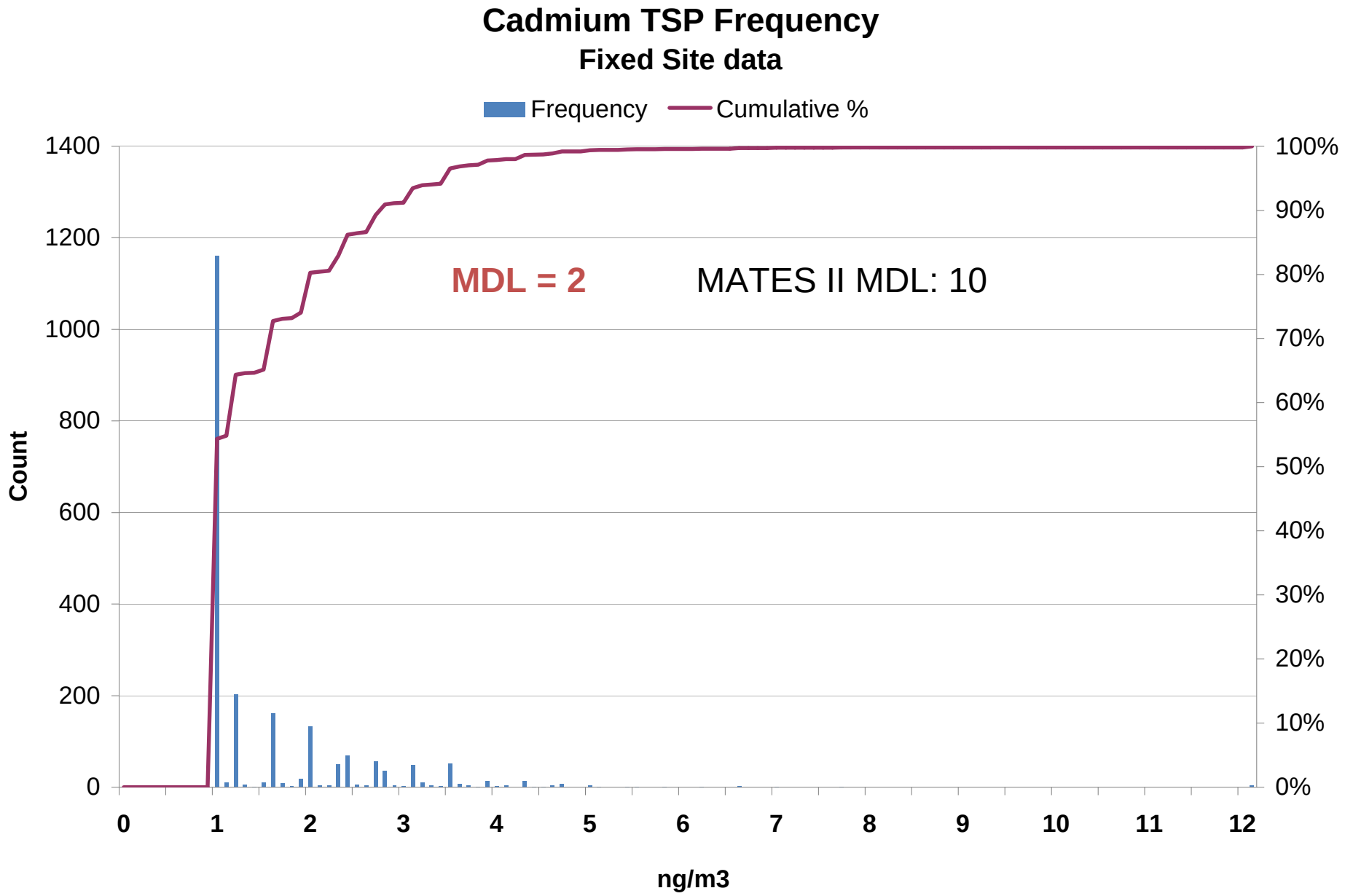
1,3-Butadiene

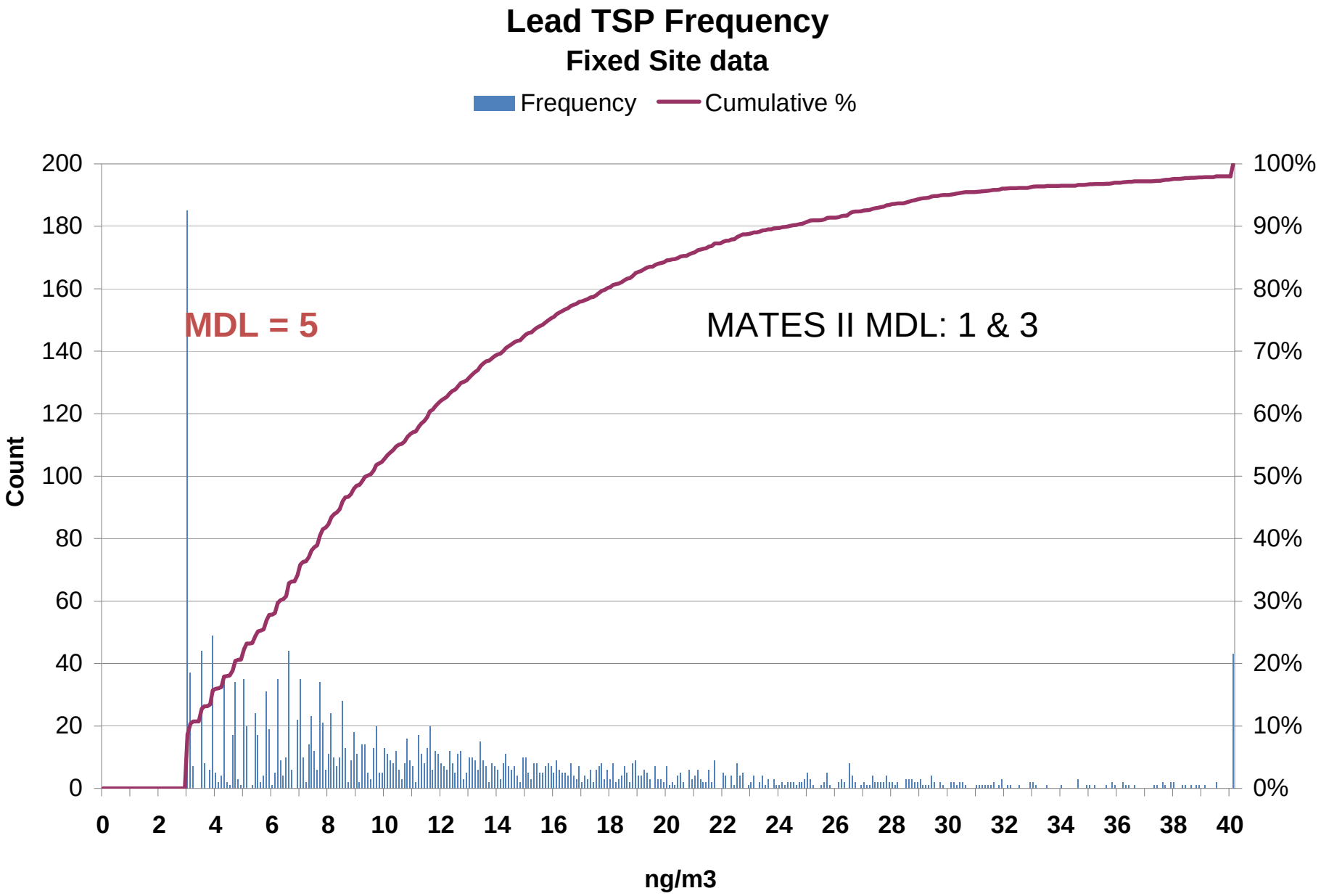


Vinyl Chloride




Arsenic TSP Frequency
Fixed Site data
Frequency
Cumulative %
MDL = 1
MATES II MDL: 4 & 3
Count
ng/m3
900
800
700
600
500
400
300
200
100
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
10
11
12


Cadmium TSP Frequency
Fixed Site data
Frequency
Cumulative %
MDL = 2
MATES II MDL: 10
Count
ng/m3
0
200
400
600
800
1000
1200
1400
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
0
1
2
3
4
5
6
7
8
9
10
11
12


Lead TSP Frequency
Fixed Site data
Frequency
Cumulative %
MDL = 5
MATES II MDL: 1 & 3
Count
ng/m3
0
20
40
60
80
100
120
140
160
180
200
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
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32
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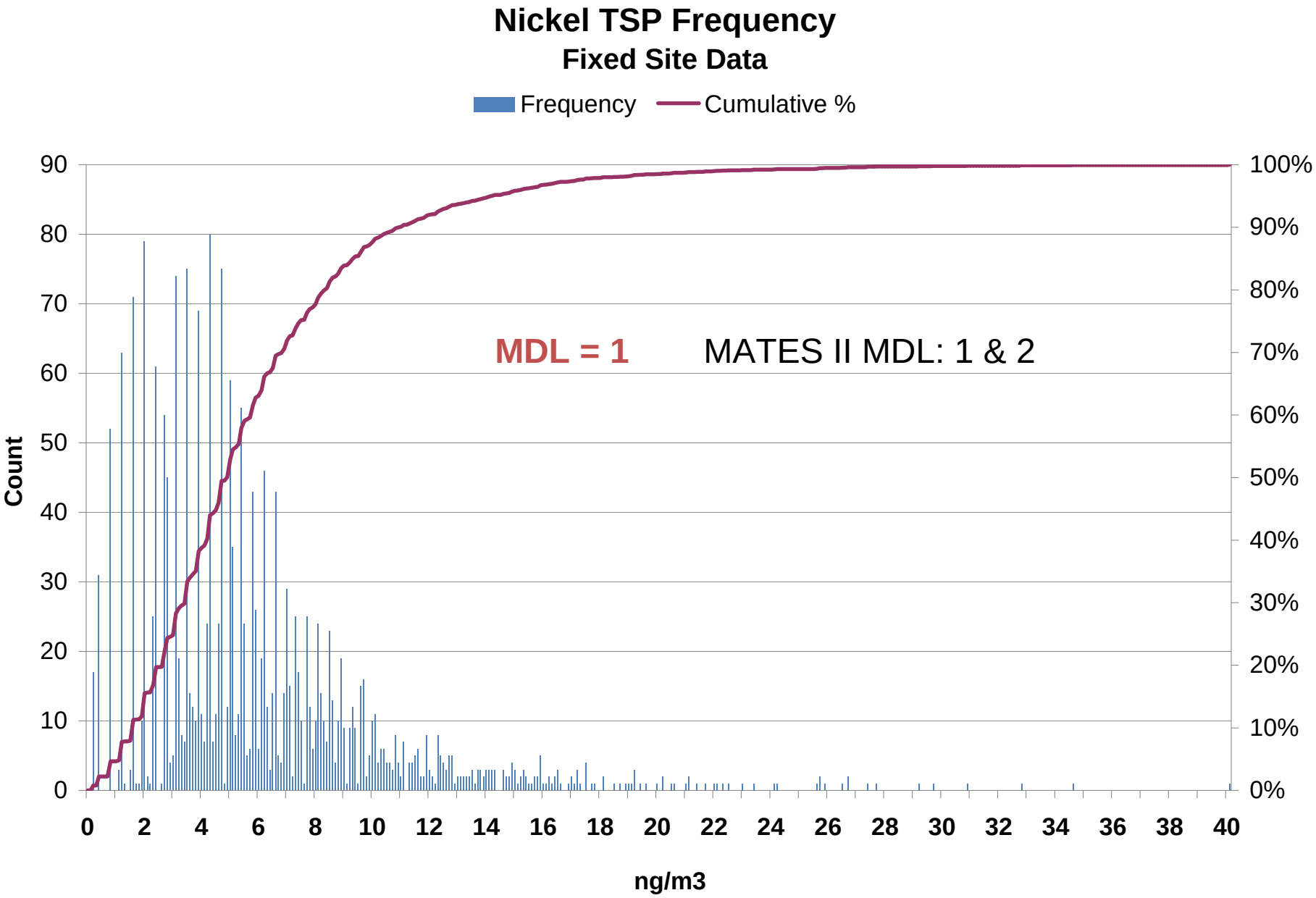
36
38
40

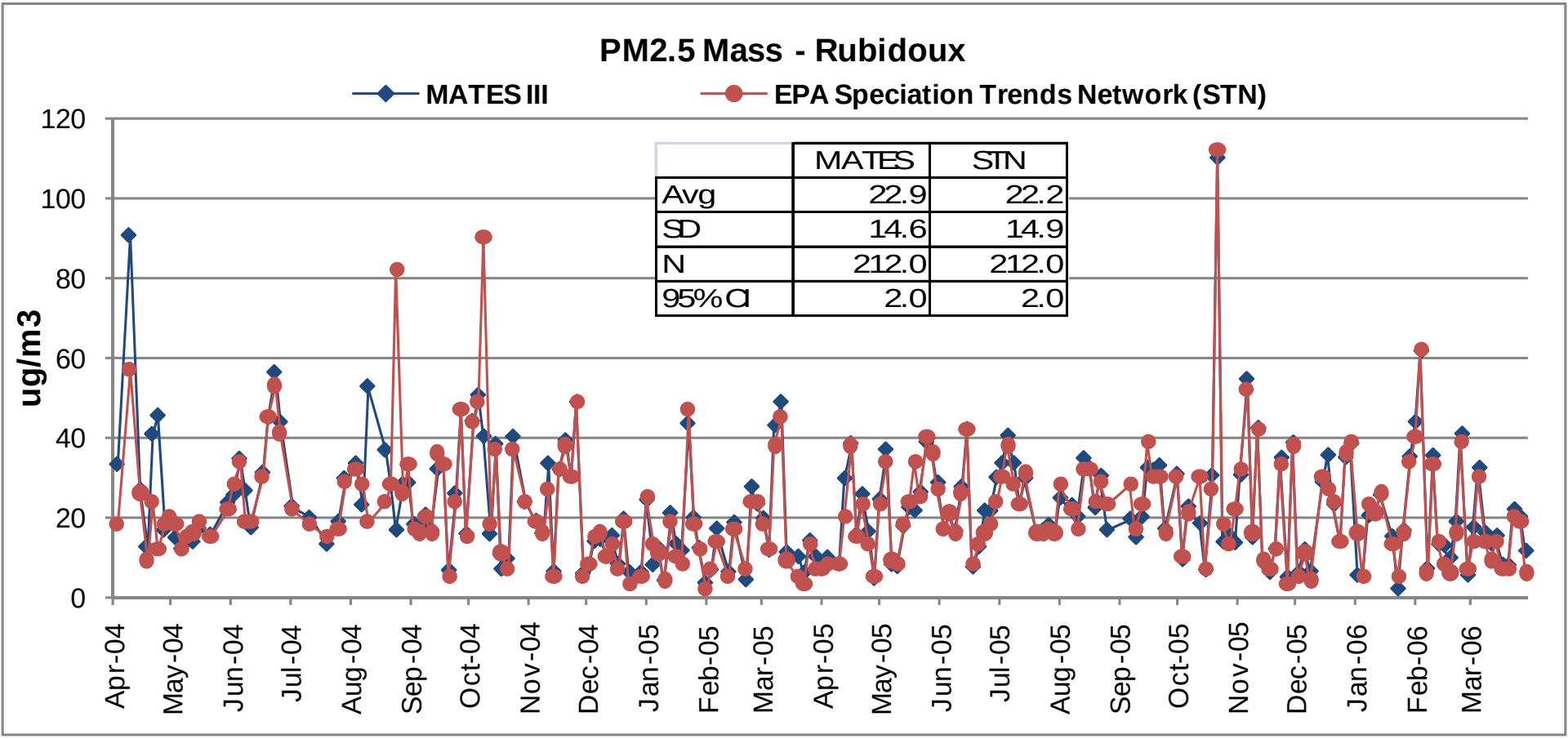

Nickel TSP Frequency
Fixed Site Data
Frequency
Cumulative %
MDL = 1
MATES II MDL: 1 & 2
Count
ng/m3
0
10
20
30
40
50
60
70
80
90
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40

Comments (cont.)

- Monitoring results
  - PM2.5 mass not consistent with CARB data
  - Did not include PM data from other sources

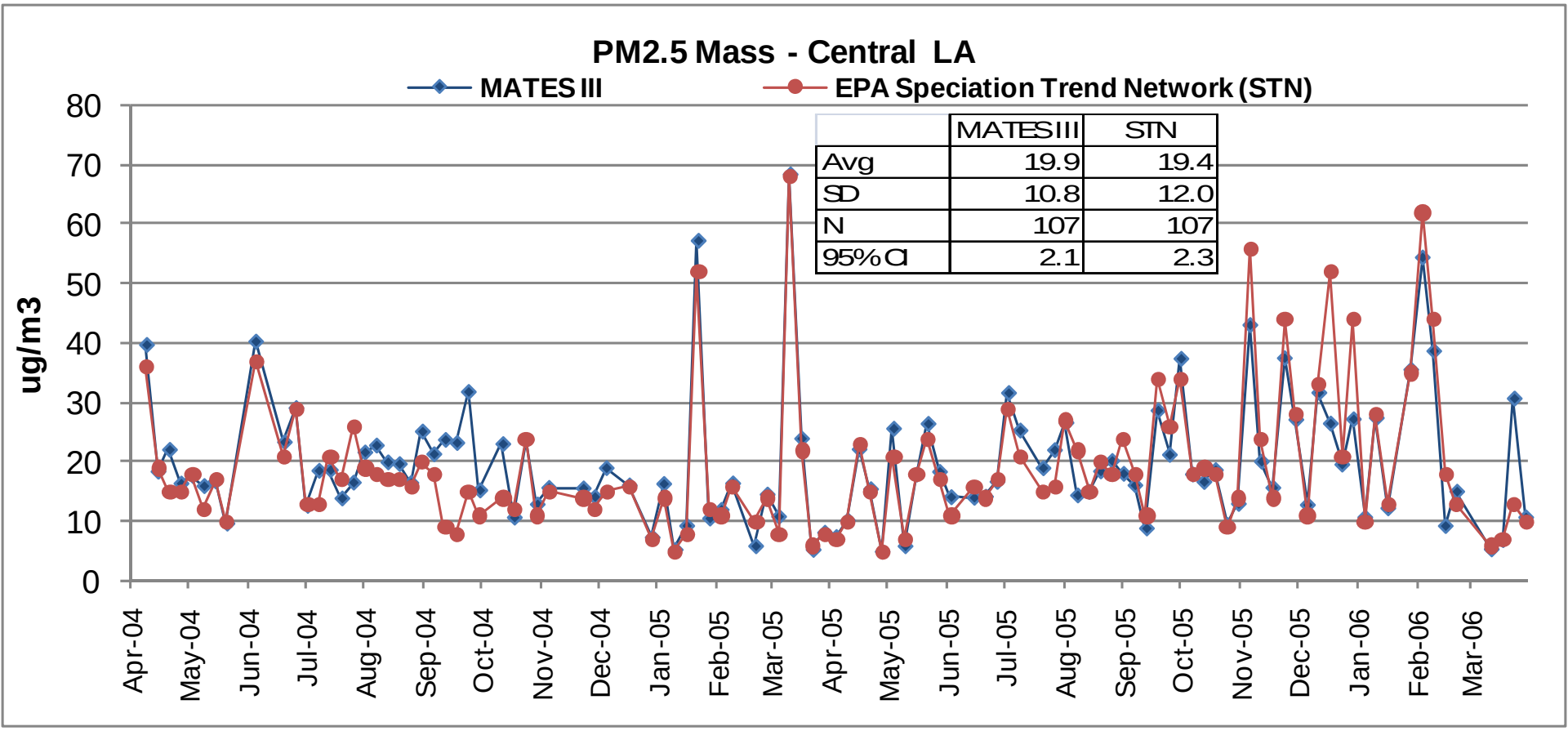
    - ✓ CARB data is from FRM samplers used for standards compliance monitoring
    - ✓ MATES III used samplers (SASS) consistent with EPA speciation trends network (STN)
    - ✓ Two sites have both SASS and STN samplers, and show agreement over MATES III study period
    - ✓ STN samplers give somewhat higher mass readings than the FRM samplers
    - ✓ Other PM data of limited use - does not include speciation for CMB use; sampling time periods differ

MATES III Compared to STN



	MATES	STN
Avg	22.9	22.2
SD	14.6	14.9
N	212.0	212.0
95% CI	2.0	2.0

MATES III Compared to STN



	MATES III	STN
Avg	19.9	19.4
SD	10.8	12.0
N	107	107
95% CI	2.1	2.3

Comments (cont.)

- Emissions Inventory
  - Discrepancies in ship emissions
  - No detail of PM2.5 DPM and EC

  ✓ Updated ship emissions category
    ✓ Small increase in ship DPM emissions
    ✓ Decrease EC fraction in ship PM emissions
  ✓ Added PM 2.5 DPM and EC in emissions tables
  ✓ Added 1998 back-cast emissions table
  ✓ Revised 2005 PM2.5 DPM/EC emissions ratio = 1.95

  ✓ Added CR+6 emissions from mobile sources

Revised DPM Estimates Comparison

Table 2-4 2005 Emissions of Diesel PM and EC, lbs./day

$PM_{2.5}$ Diesel PM	$PM_{2.5}$ EC	DPM/EC Ratio
55,983	28,761	1.95

Table 2-5 Estimates of Average Diesel PM, μg/m3

Estimation Method	MATES III Year One	MATES III Year Two
MATES II: PM_{10} EC x 1.04	2.18	2.14
2005 Inventory: $PM_{2.5}$ EC x 1.95	3.37	3.70
CMB	2.87 – 3.13	3.52 – 3.84

Revised Table 3-6

Table 3-6. Selected Emissions and Air Quality Changes Since MATES II.

Toxic Gases	Change in Emissions	Change in Air Quality
Acetaldehyde	-9%	-8%
Benzene	-36%	-47%
1,3-butadiene	-31%	-67%
Formaldehyde	-21%	-9%
Methylene chloride	-38%	-43%
Perchloroethylene	-58%	-77%
Trichloroethylene	-65%	-79%

Toxic Particulates	Change in Emissions	Change in Air Quality
Arsenic**	-20%	-54%
Cadmium**	-20%	-74%
Elemental carbon	-3%	-28%*
Hex. chromium	-53%	-5%
Lead	-14%	-47%
Nickel	-22%	-31%

Notes:
* Adjusted for instrumentation changes in MATES III; see Section 2.6.3.
** Difference in air quality may be in part due to lower laboratory reporting limits in MATES III.
Emissions: 2005 compared to 1998.
Air Quality: MATES III year 1 compared to MATES II annual averages from 10 fixed sites.

Comments (cont.)

- Chemical Mass Balance method
  - Not appropriate to use CMB calculations: estimate of DPM biased high
  - Natural gas not included as a source
    - ✓ Minor source of PM emissions
  - Secondary organics not considered as a source
    - ✓ No speciation profile available; unapportioned mass sometimes considered as secondary organics
  - Calculated (apportioned) mass higher than measured mass
    - ✓ Apportioned mass within 20% of measured mass – generally acceptable CMB model performance
    - ✓ CMB best method available; TAG recommendation

Comments (cont.)

- Modeling
  - Effect of alternate vertical mixing parameters
  - “Apples to apples” comparison with MATES II
  - More detailed maps of modeled air toxics risks with additional risk cut points

CAMx/MM5 Modeling Sensitivity

MATES-III 2005

- ✓ Tested 8 vs. 16 layers - no significant difference
- ✓ Tested different vertical mixing schemes
- ✓ Used alternate shipping emissions profile – lowered EC percentage of PM emissions per comments received (No impact on total diesel PM emissions)

- ✓ Achieved better model fit to monitored EC values

Comparison of EC2.5 Observed vs Model Simulated for Varying Layer Structures and Vertical Diffusivity Schemes

(Performance is Presented as a Ratio of Modeled/Observed)

		CMAQ					Obrien 70			
		Draft	**Interim**							
Location	OBS	**8 Layers**	**8 Layers**	16 Layers	16 Layers	16 Layers	8 Layers	8 Layers	16 Layers	16 layers
		1.0 kv	**0.1 kv KVP**	1.0 kv	0.1 kv	0.1 kv, KVP	0.1 kv KVP	0.1 kv	0.1 kv	0.1 kv KVP
Anaheim	1.00	**1.03**	**1.07**	1.01	1.57	1.10	1.21	1.77	1.66	1.24
Burbank	1.00	**0.53**	**0.54**	0.54	0.73	0.57	0.61	0.78	0.81	0.63
Compton	1.00	**1.12**	**1.15**	1.10	1.76	1.18	1.29	1.97	1.81	1.32
Fontana	1.00	**0.72**	**0.88**	0.73	1.12	0.88	1.00	1.28	1.17	0.98
HuntingtonPark	1.00	**0.94**	**0.96**	0.92	1.44	0.98	1.07	1.62	1.47	1.08
Long Beach	1.00	**1.42**	**1.47**	1.41	2.13	1.51	1.63	2.38	2.17	1.67
Los Angeles	1.00	**1.09**	**1.11**	1.06	1.59	1.12	1.26	1.83	1.69	1.25
Pico Rivera	1.00	**0.76**	**0.85**	0.77	1.21	0.89	0.95	1.33	1.28	0.97
Rubidoux	1.00	**0.60**	**0.84**	0.64	0.98	0.89	0.93	1.00	1.02	0.94
Wilmington	1.00	**1.22**	**1.26**	1.17	1.61	1.26	1.38	1.82	1.60	1.36

Comparison of EC2.5 Observed vs Model Simulated for Revised Marine EC2.5 Emissions Profile

(Performance is Presented as a Ratio of Modeled/Observed)

Location	Observed	Initial	Interim	Final
Anaheim	1.00	1.03	1.07	**0.94**
Burbank	1.00	0.53	0.54	**0.50**
Compton	1.00	1.12	1.15	**1.04**
Inland Valley, S.B.	1.00	0.72	0.88	**0.84**
Huntington Park	1.00	0.94	0.96	**0.91**
North Long Beach	1.00	1.42	1.47	**1.26**
Central Los Angeles	1.00	1.09	1.11	**1.06**
Pico Rivera	1.00	0.76	0.85	**0.80**
Rubidoux	1.00	0.60	0.84	**0.80**
West Long Beach	1.00	1.22	1.26	**1.04**

Applied CAMx Model to MATES II

MATES-II: 1998-99

- ✓ Created 1998-99 MM5 meteorological data fields
- ✓ Created comparable CAMx input files (layer structure, mixing & source characteristics)
- ✓ Simulated back cast 1998-99 emissions
- ✓ Risk calculated for 1998 population

CAMx RTRAC Simulated and Measured: Six-Station Annual Average Concentrations

Toxic 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
Cr6 (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	5.37	2.58	N/A	N/A
Pb (TSP)	ng/m^3	3.12	8.9	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
1,3Butadiene	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

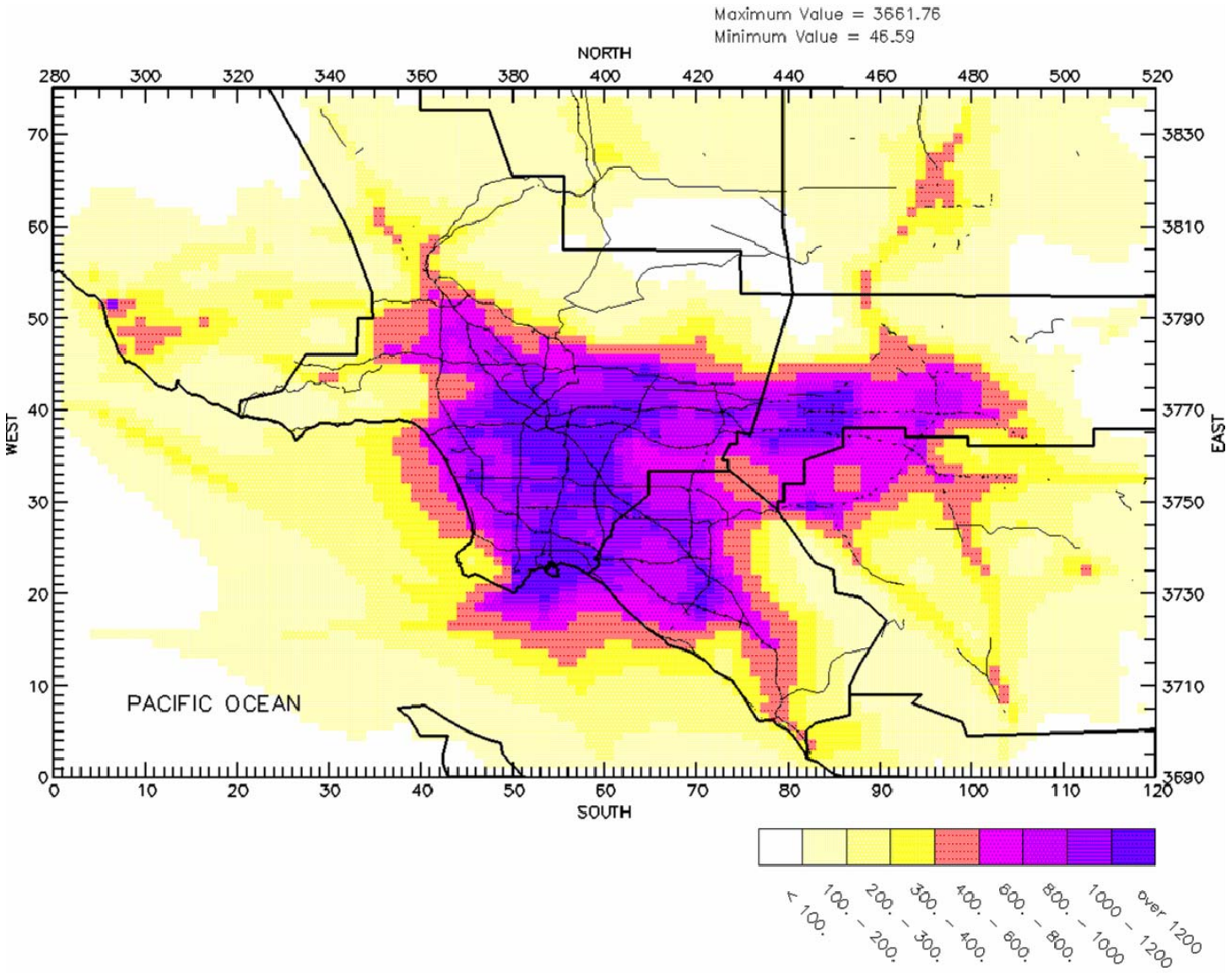
* Two station average

Model Risk Update Summary

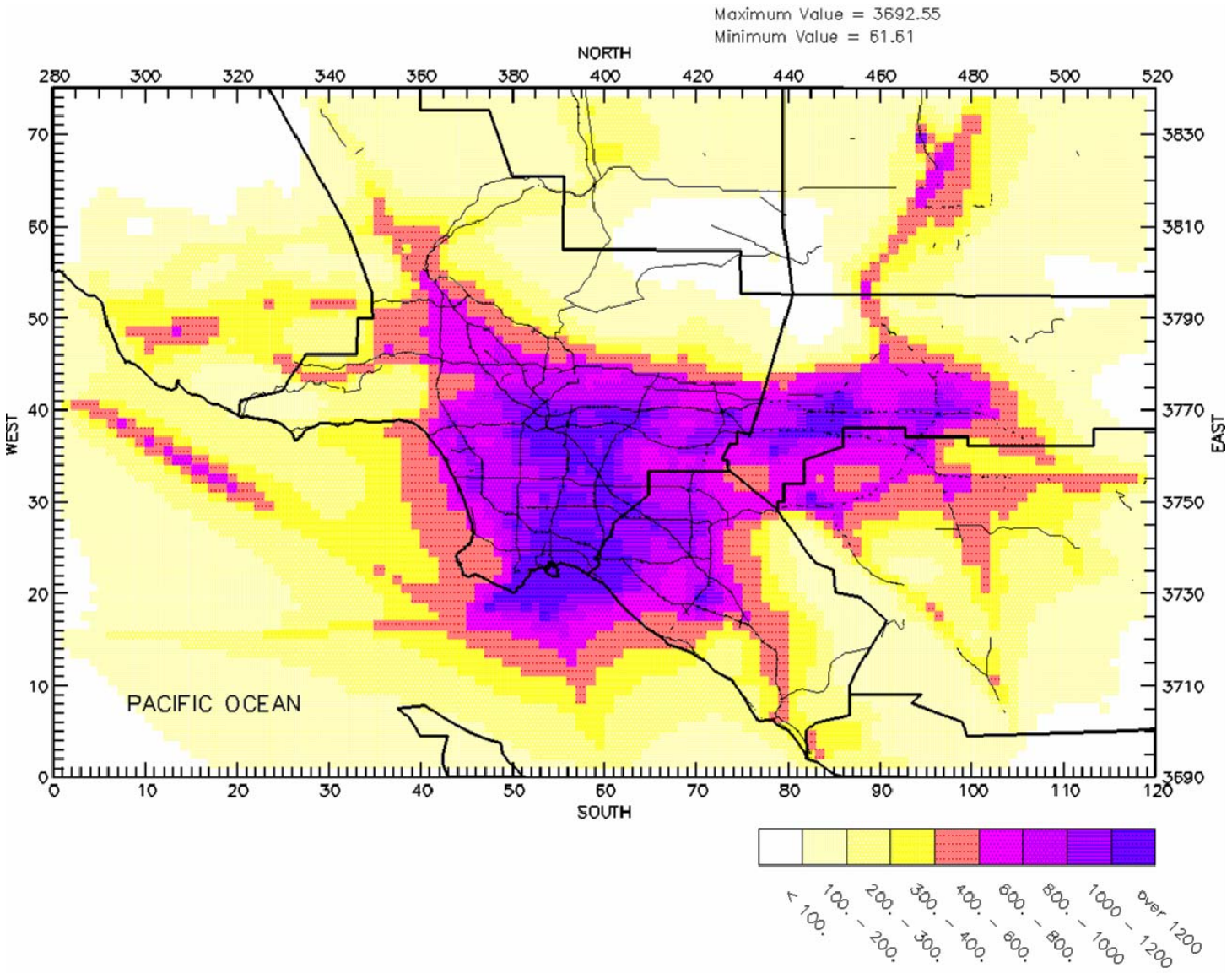
Revised CAMX RTRAC

- ✓ 2005 MATES-III population weighted risk changes from 810 to 853 per million
- ✓ 1998-99 back-cast projection is 931 per million
- ✓ Highest risk grid cells in ports area
- ✓ 8% decrease in basin wide population weighted risk from MATES II to MATES III

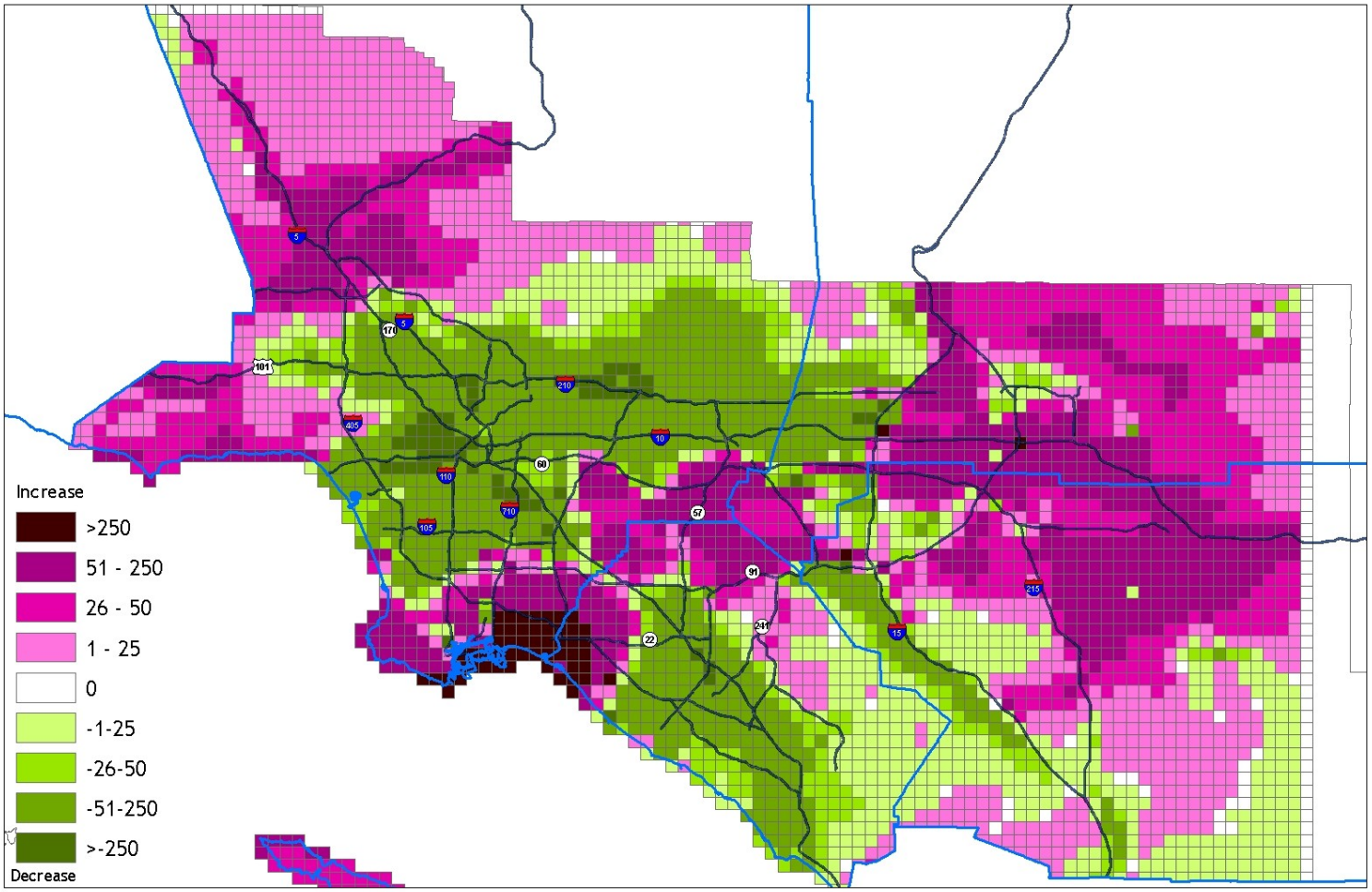
1998-99 MATES II CAMx RTRAC Simulated Cumulative Risk



2005 MATES III CAMx RTRAC Simulated Cumulative Risk



Modeled Air Toxics Risk Difference Between 2005 & 1998 - 99

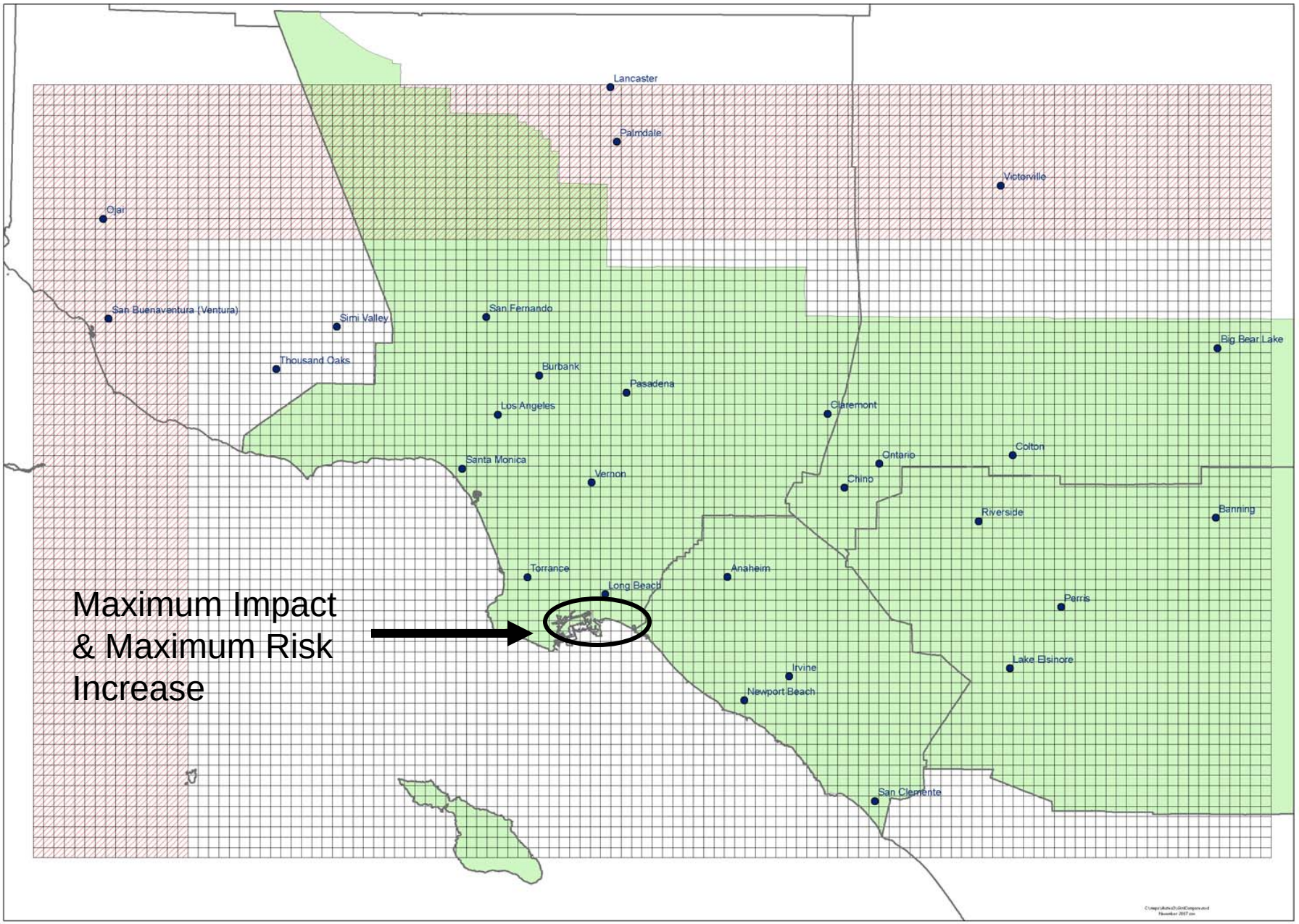


Change in CAMx RTRAC Air Toxics Simulated Risk (per million) from 1998-99 to 2005 Using Back-Cast 1998 Emissions and 1998-99 MM5 Generated Meteorological Data Fields

County-Wide Population Weighted Risk

Region	MATES III		MATES II*		Percentage Change
	2005 Population	Average Risk (Per Million)	1998 Population	Average Risk (Per Million)	
Los Angeles	9,887,127	951	9,305,726	1047	-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

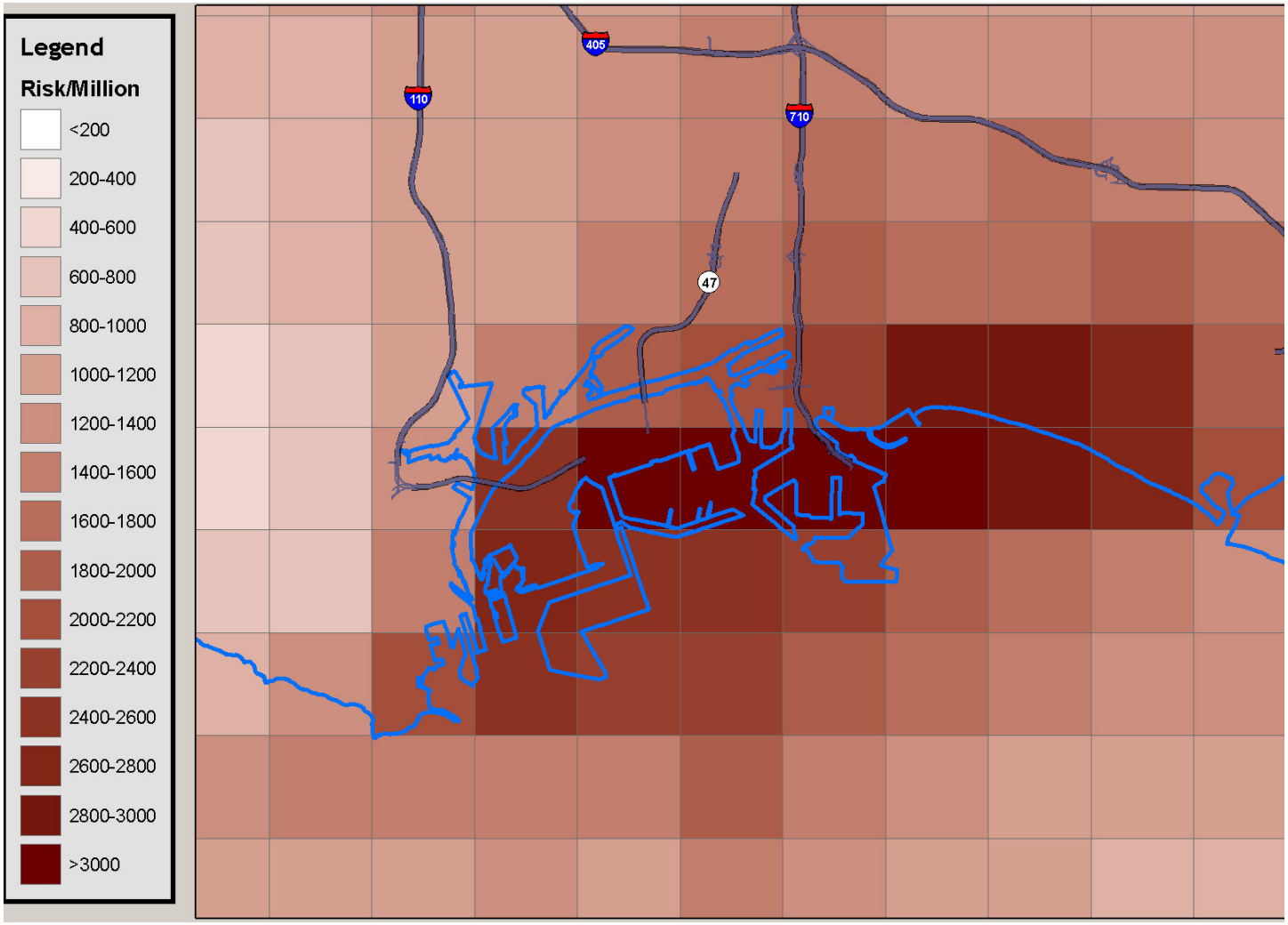

Lancaster
Palmdale
Victorville
Ojai
San Buenaventura (Ventura)
Simi Valley
San Fernando
Big Bear Lake
Thousand Oaks
Burbank
Pasadena
Los Angeles
Claremont
Santa Monica
Vernon
Ontario
Colton
Chino
Riverside
Banning
Torrance
Anaheim
Long Beach
Perris
Irvine
Lake Elsinore
Newport Beach
San Clemente
Maximum Impact
& Maximum Risk
Increase

Model Risk Update – Ports Area

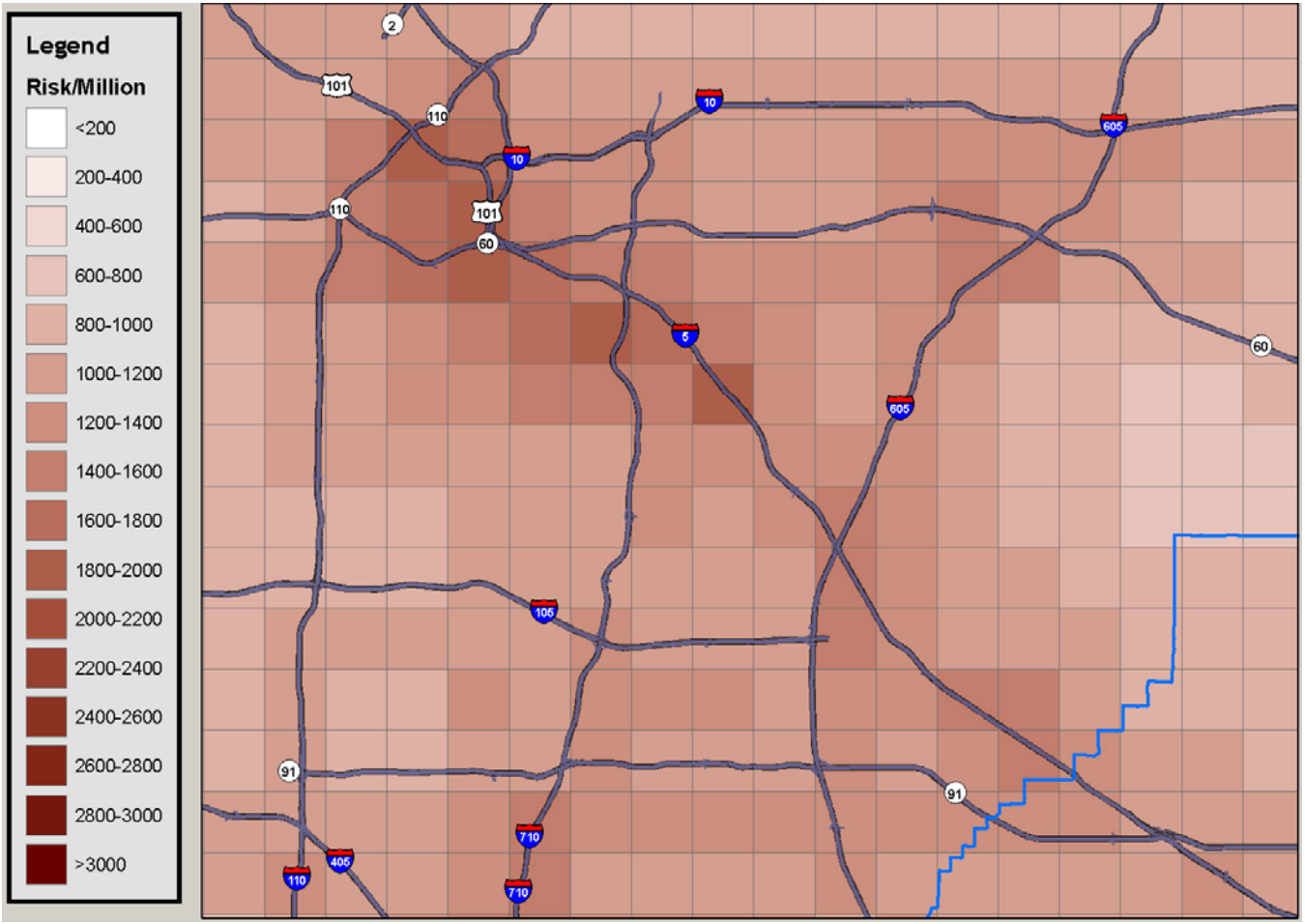
Revised CAMX RTRAC

- Looked at 2005 model results around ports
- Ports area: 10 x10 grid cell area
- Port area shows increased population weighted risk from 1998-99 to 2005:
- 1208 → 1415 per million

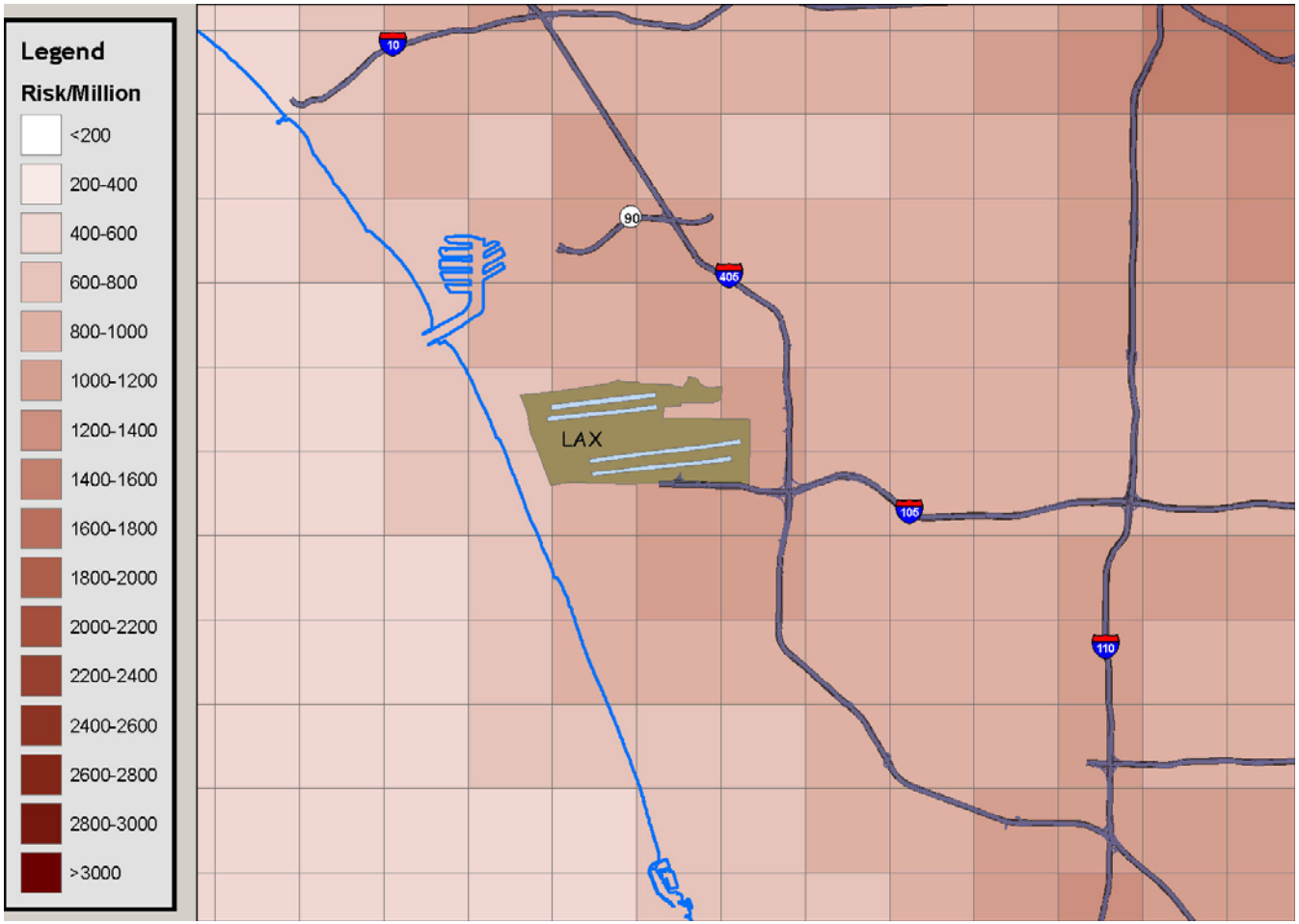
2005 Ports area MATES III Simulated Cumulative Risk



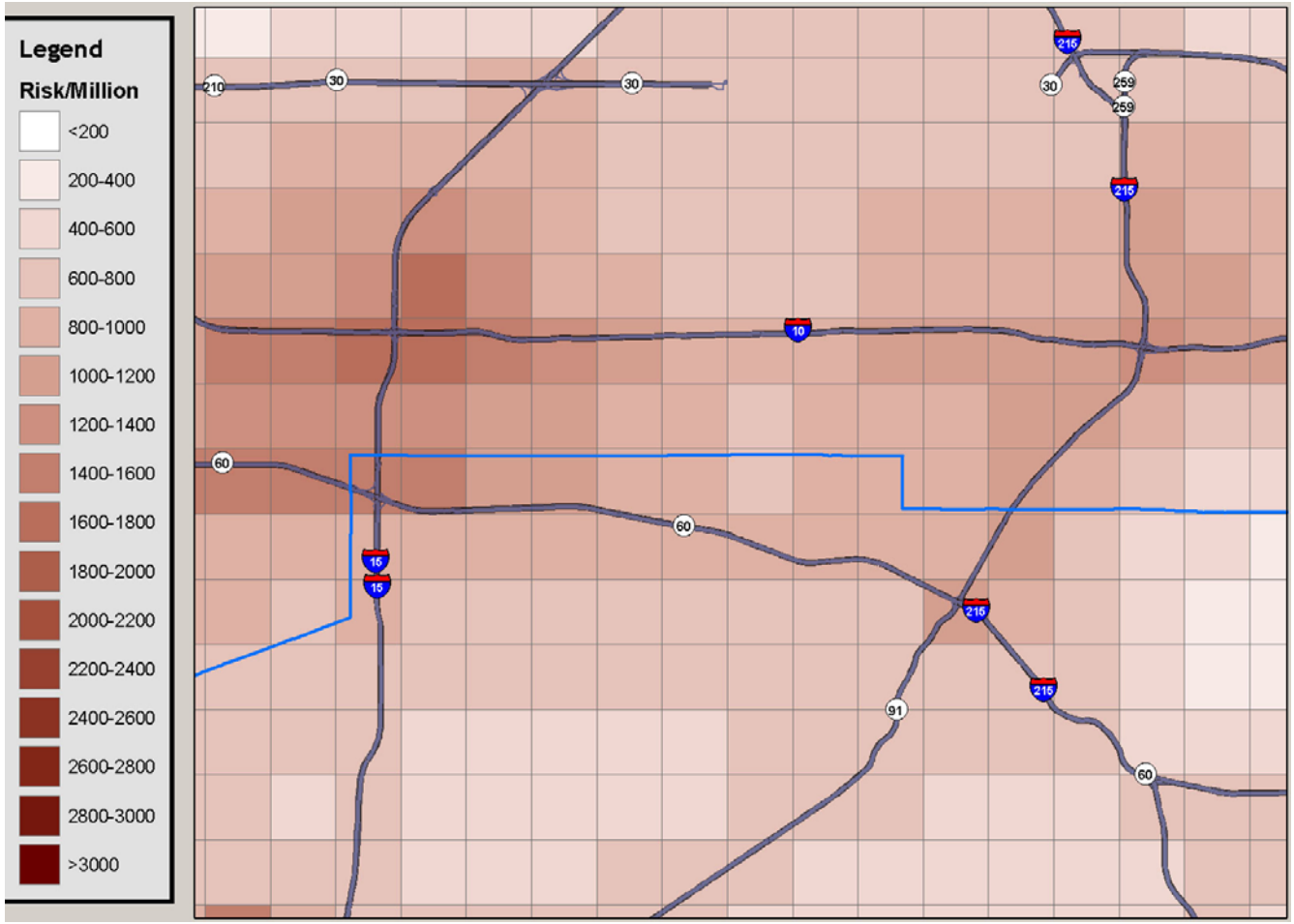
2005 Central Los Angeles MATES III Simulated Cumulative Risk



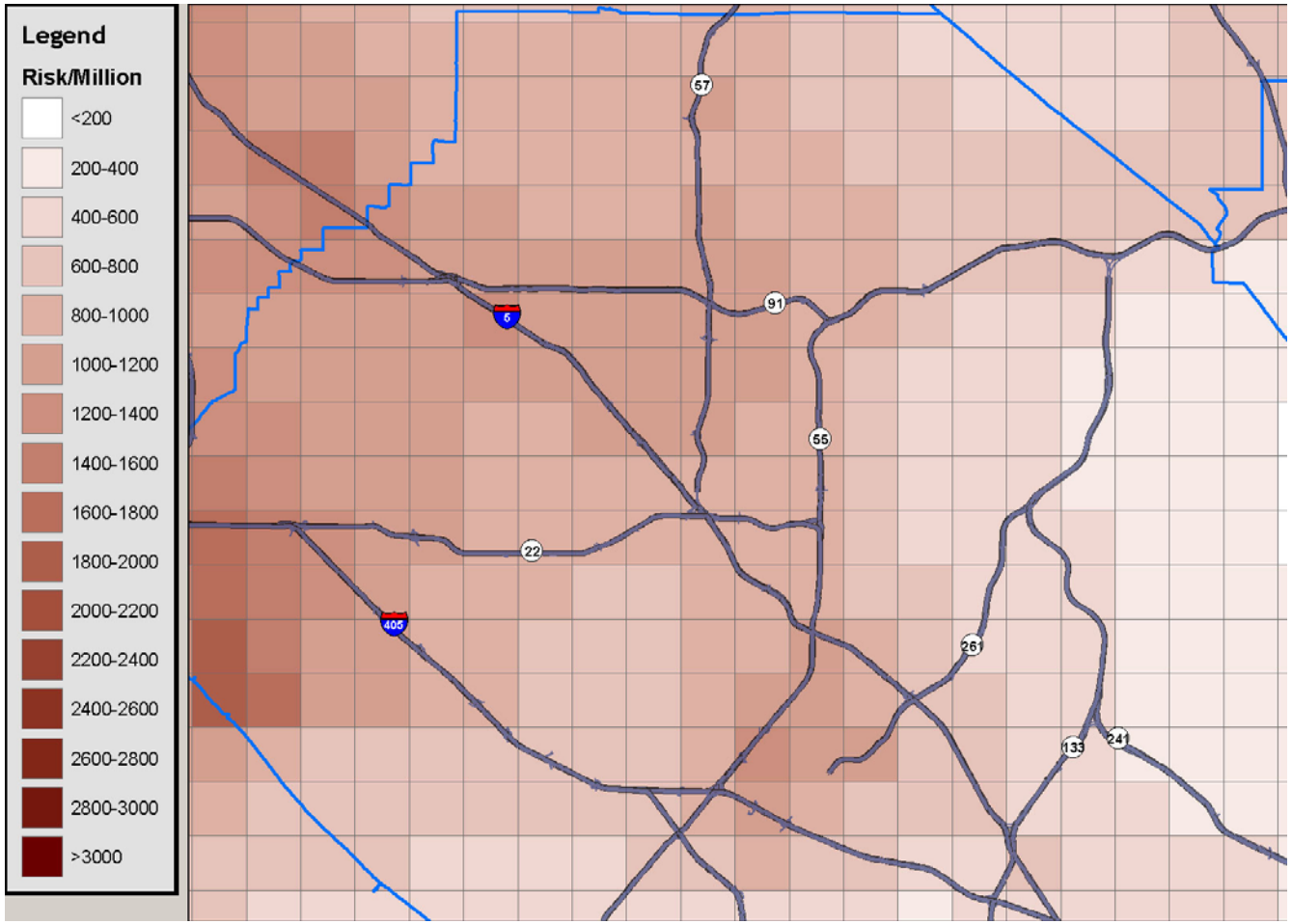
2005 West Los Angeles MATES III Simulated Cumulative Risk



2005 Mira Loma/Colton MATES III Simulated Cumulative Risk



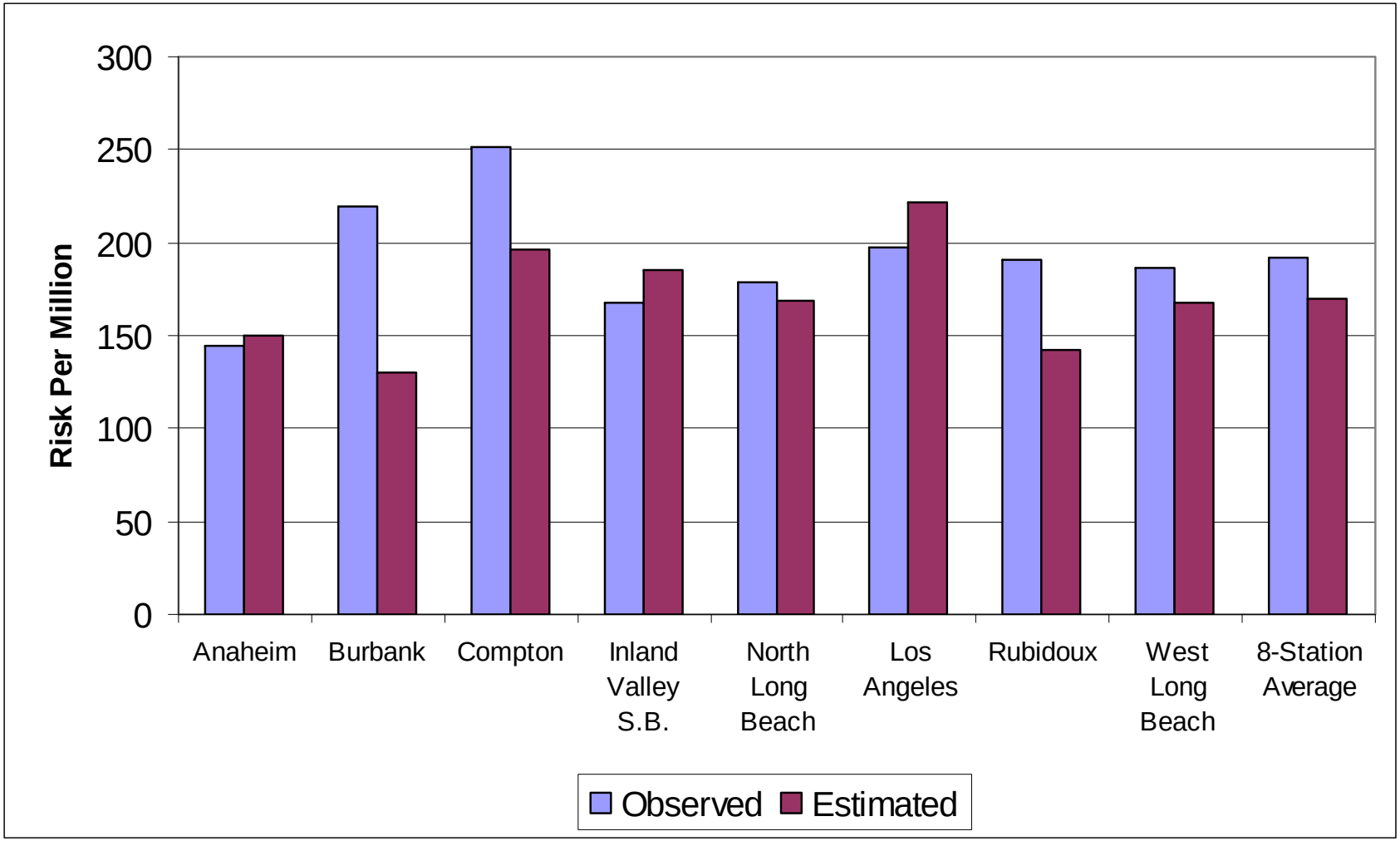
2005 Northern Orange County MATES III Simulated Cumulative Risk



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	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

2005 MATES III Simulated Vs. Measured Compounds NonDiesel Air Toxics Risk



Revised Non-Cancer Assessment

- Compared annual averages to OEHHA chronic Reference Exposure Levels (CRELs)
- Formaldehyde
  - All fixed sites above CREL of 2 ppb
    - Sites average at 3.6 ppb
    - OEHHA proposes to raise CREL to 7 ppb
    - All sites below proposed CREL
- Manganese
  - All sites well below current CREL of 200 ng/m3
  - ✓ OEHHA proposes to lower CREL to 130 ng/m3
  - ✓ All sites below proposed CREL:
    - Inland Valley S.B. : 61.8 ng/m^3
    - Rubidoux: 47.7 ng/m^3
    - Huntington Park: 32.0 ng/m^3

Summary of MATES III Findings Compared to MATES II

- Monitoring
  - 10 site average air toxics risk decrease of 15%
- Emissions Inventory – potency weighted emissions
  - Decrease of 11% basin wide
  - Increase of 48% in ships/commercial boats DPM
- Modeling – population weighted risk
  - Decrease of 8% basin wide
  - Increase of 17% in area near ports

Next steps

- Public Consultation Meeting
  - August 26, 2008
- Complete revisions to report
- Final to Board in September