Multiple Air Toxics Exposure Study – MATES IV

South Coast AQMD

Air Toxics Monitoring and Data Analysis Workshop

October 27, 2015

Background

- MATES I: 1987
- MATES II: 1998-99
- MATES III: 2004-2006
- MATES IV: 2012-2013
- Environmental Justice Initiative
- Focus on toxics exposure and risk
    - PM mortality not included

Purpose

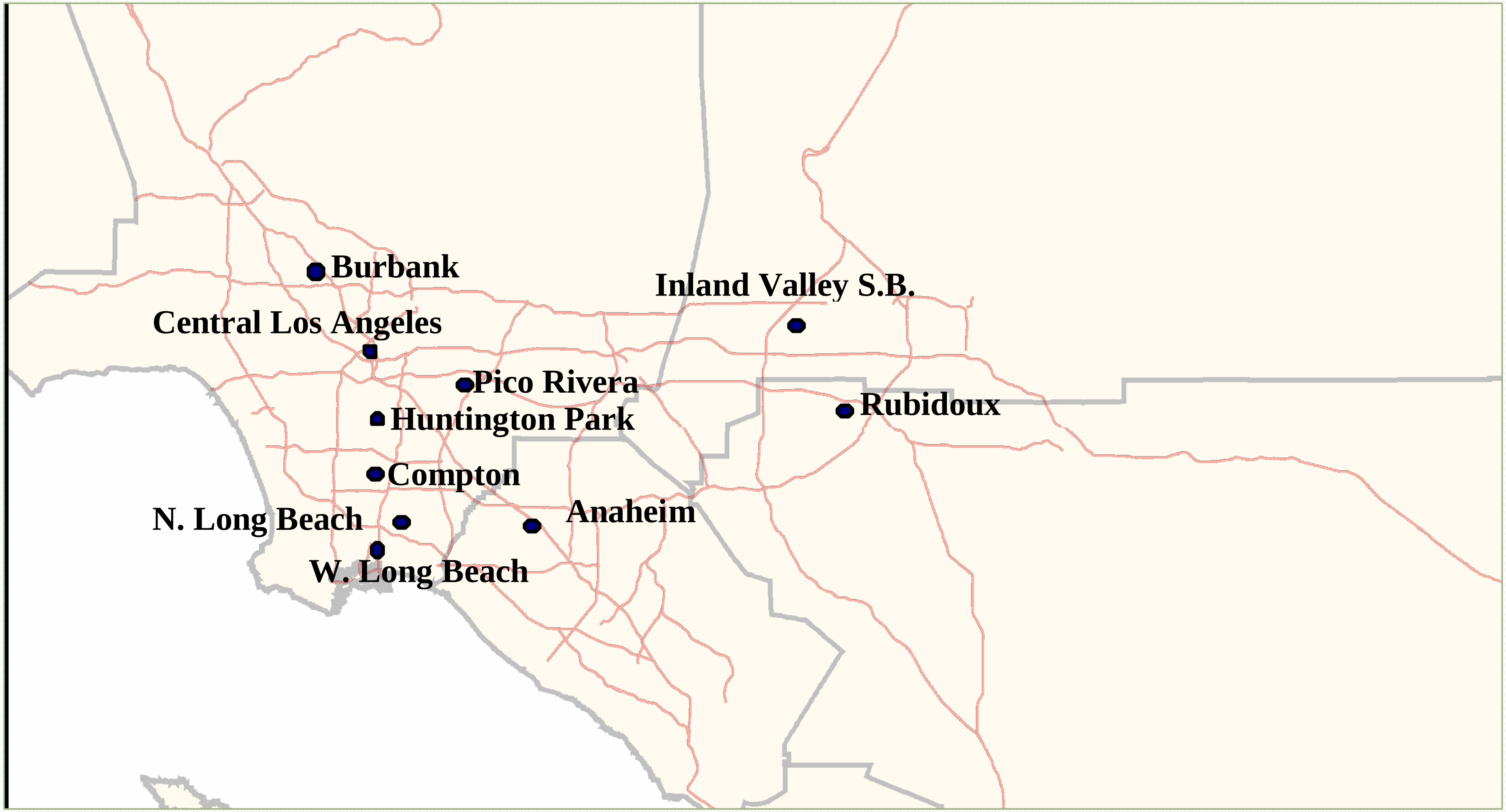
- Provide the public with information on toxic exposure and risk
- Evaluate progress in reducing air toxics exposure
- Provide direction to future toxics control programs

Key Components

- Monitoring
  - Added black carbon & ultrafine particle counts
  - Improved analysis methods
  - PAH at selected sites
- Emissions inventory
  - Based on latest 2012 AQMP inventory
- Modeling
  - Consistent with AQMP modeling platform
  - Extended to include Coachella Valley
- Technical Advisory Group
  - Input on study plan and draft report

MATES IV Monitoring Sites

10 sites, every 6th day, July 2012 – June 2013



Substances Measured

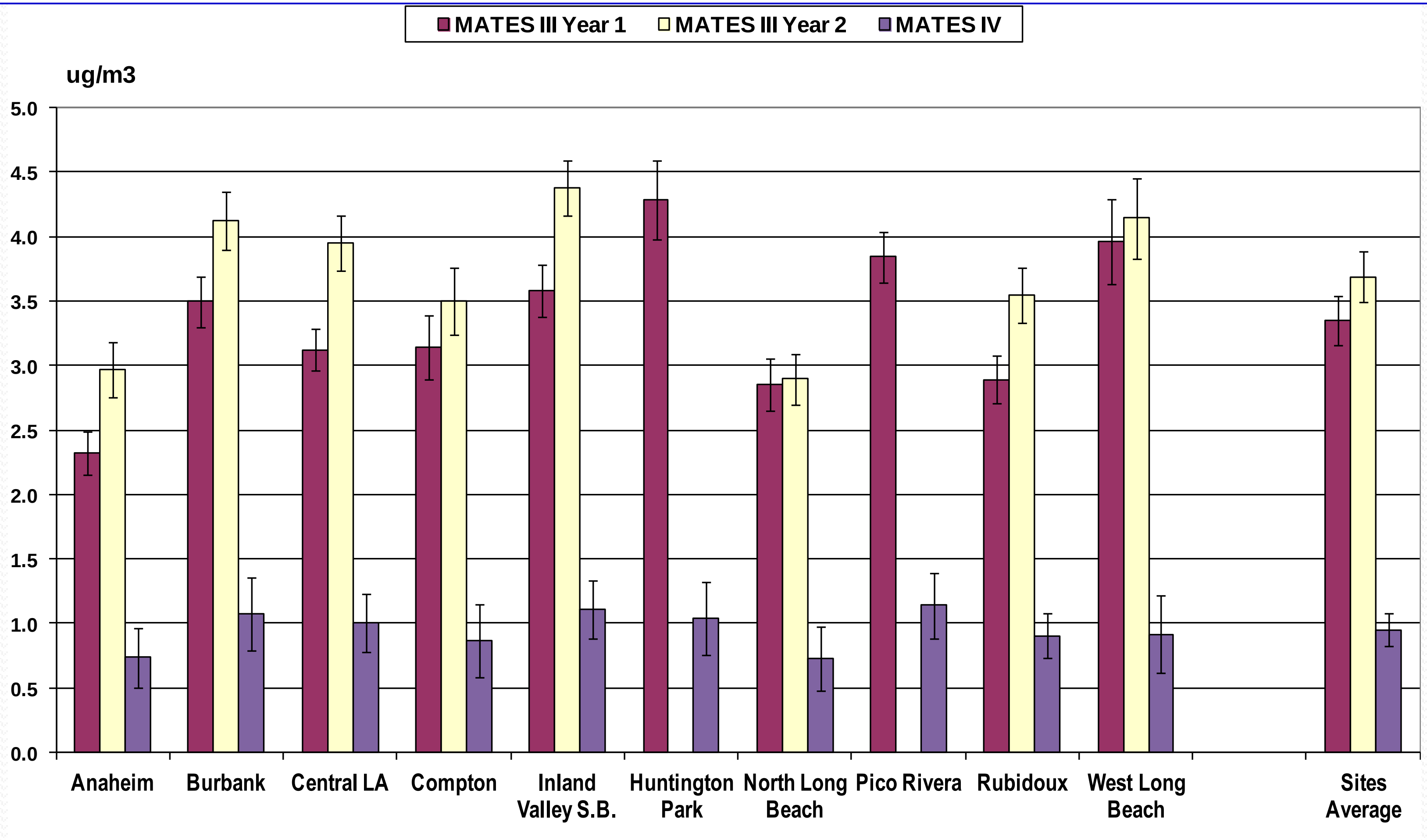
Acetaldehyde	**Dichloroethane**	**Organic Carbon (OC)**
Acetone	**Elemental Carbon (EC)**	**PAHs**
Arsenic	**Ethyl Benzene**	**Perchloroethylene**
Benzene	**Formaldehyde**	**$PM_{2.5}$**
Black Carbon (BC)	**Hexavalent Chromium**	**PM_{10}**
1,3-Butadiene	**Lead**	**Selenium**
Cadmium	**Manganese**	**Styrene**
Carbon Tetrachloride	**Methylene Chloride**	**Toluene**
Chloroform	**Methyl ethyl ketone**	**Trichloroethylene**
Copper	**MTBE**	**Ultrafine Particles (UFP)**
Dibromoethane	**Naphthalene**	**Vinyl Chloride**
Dichlorobenzene	**Nickel**	**Xylene**
		Zinc

Summary of Major MATES IV Findings

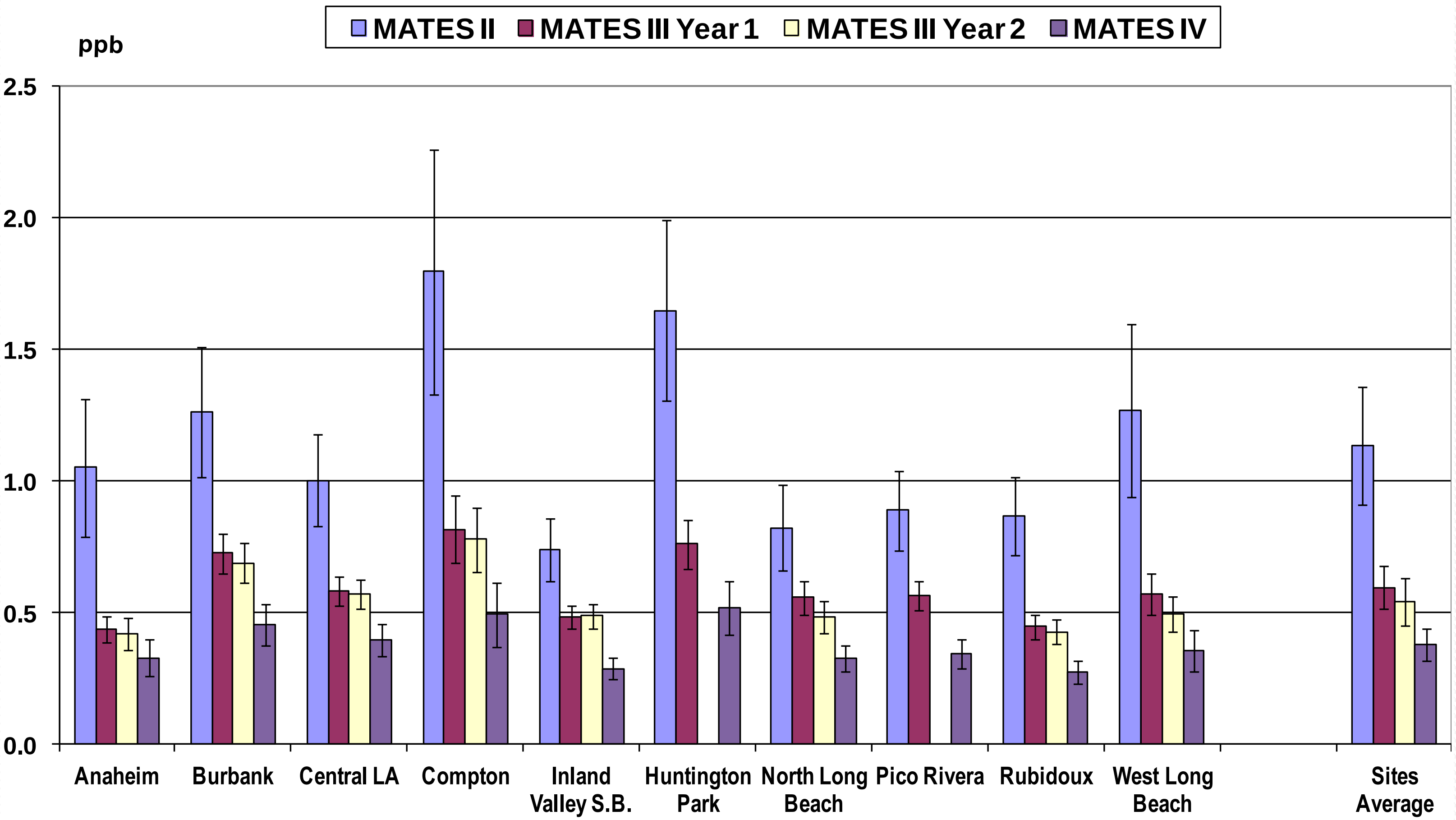
- Cancer Risk has decreased more than 50% between MATES III (2005) and MATES IV (2012)
  - Monitoring, inventory, and modeling approaches all produce similar results
- While Diesel PM exposure decreased by ~70%, it still dominates the overall cancer risk from air toxics
- Highest risk areas near ports and transportation corridors
- Risk from other air toxics continue to decline, with limited exceptions
- Ultrafine Particle measurements show higher levels in areas with higher population and traffic density

Diesel PM Estimates

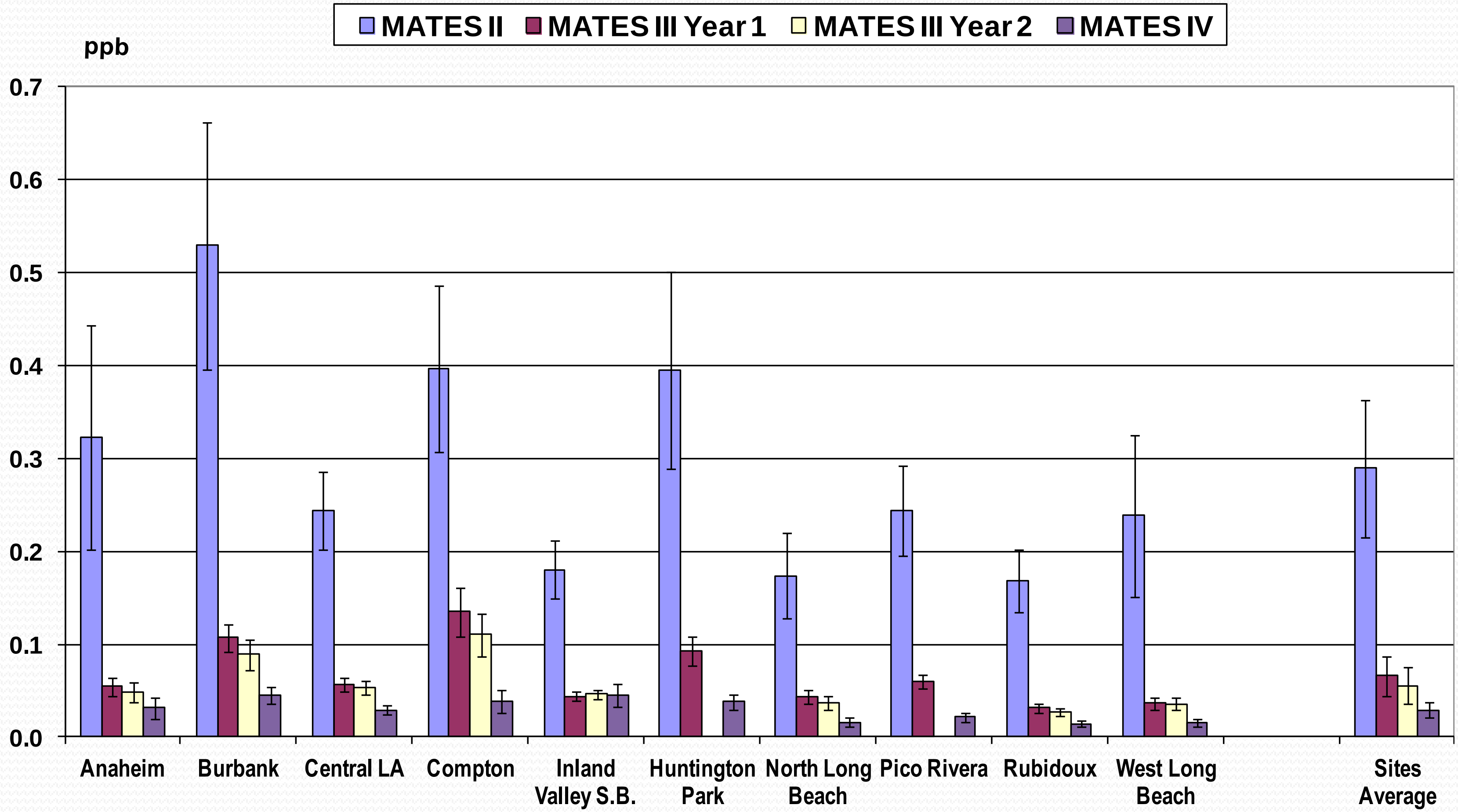
MATES IV Diesel PM ~70% lower compared to MATES III
using emissions ratio method



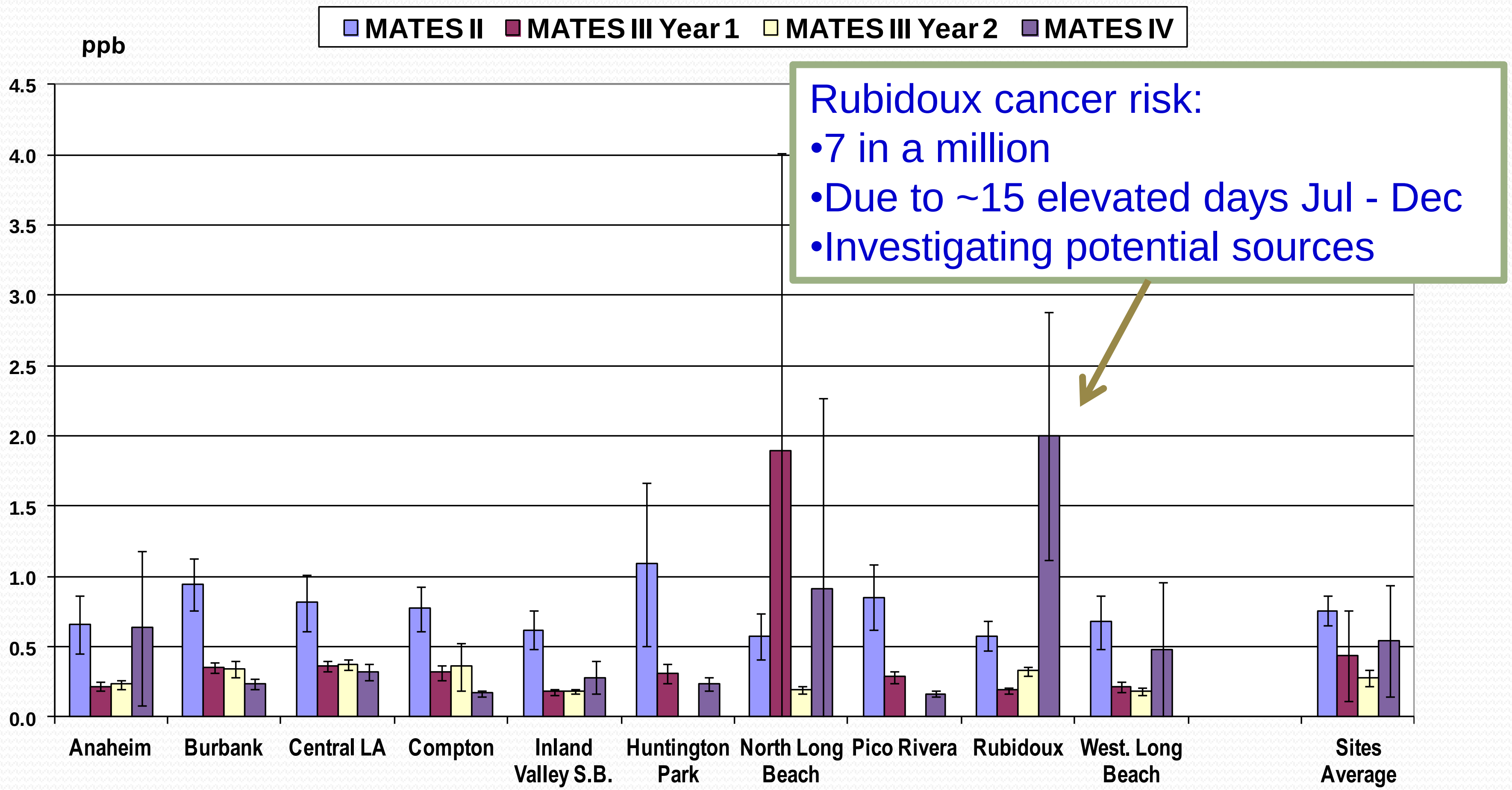
Benzene


MATES II
MATES III Year 1
MATES III Year 2
MATES IV
ppb
2.5
2.0
1.5
1.0
0.5
0.0
Anaheim
Burbank
Central LA
Compton
Inland Valley S.B.
Huntington Park
North Long Beach
Pico Rivera
Rubidoux
West Long Beach
Sites Average

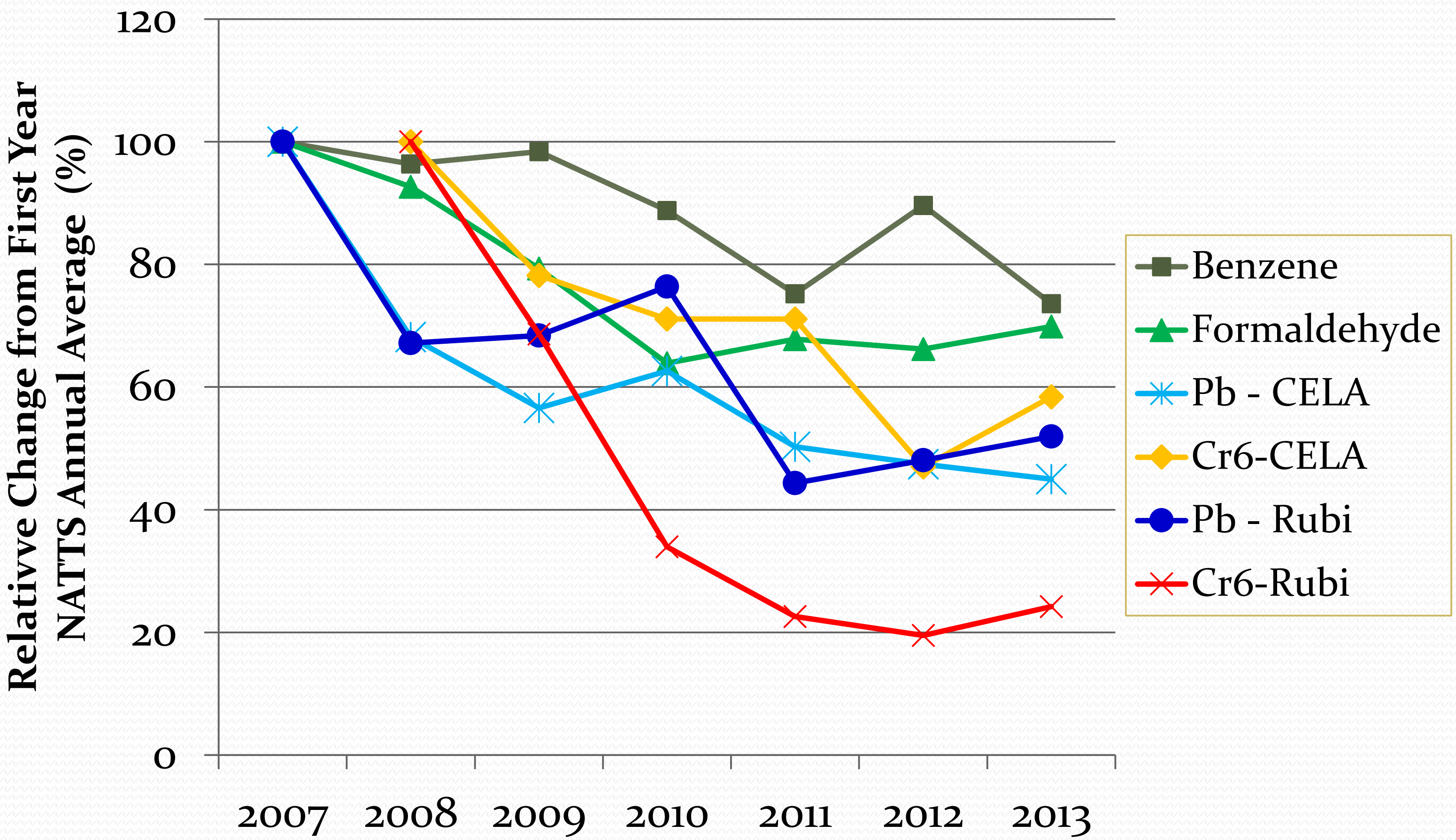
Perchloroethylene



Methylene Chloride



NATTS Trends for Selected Pollutants



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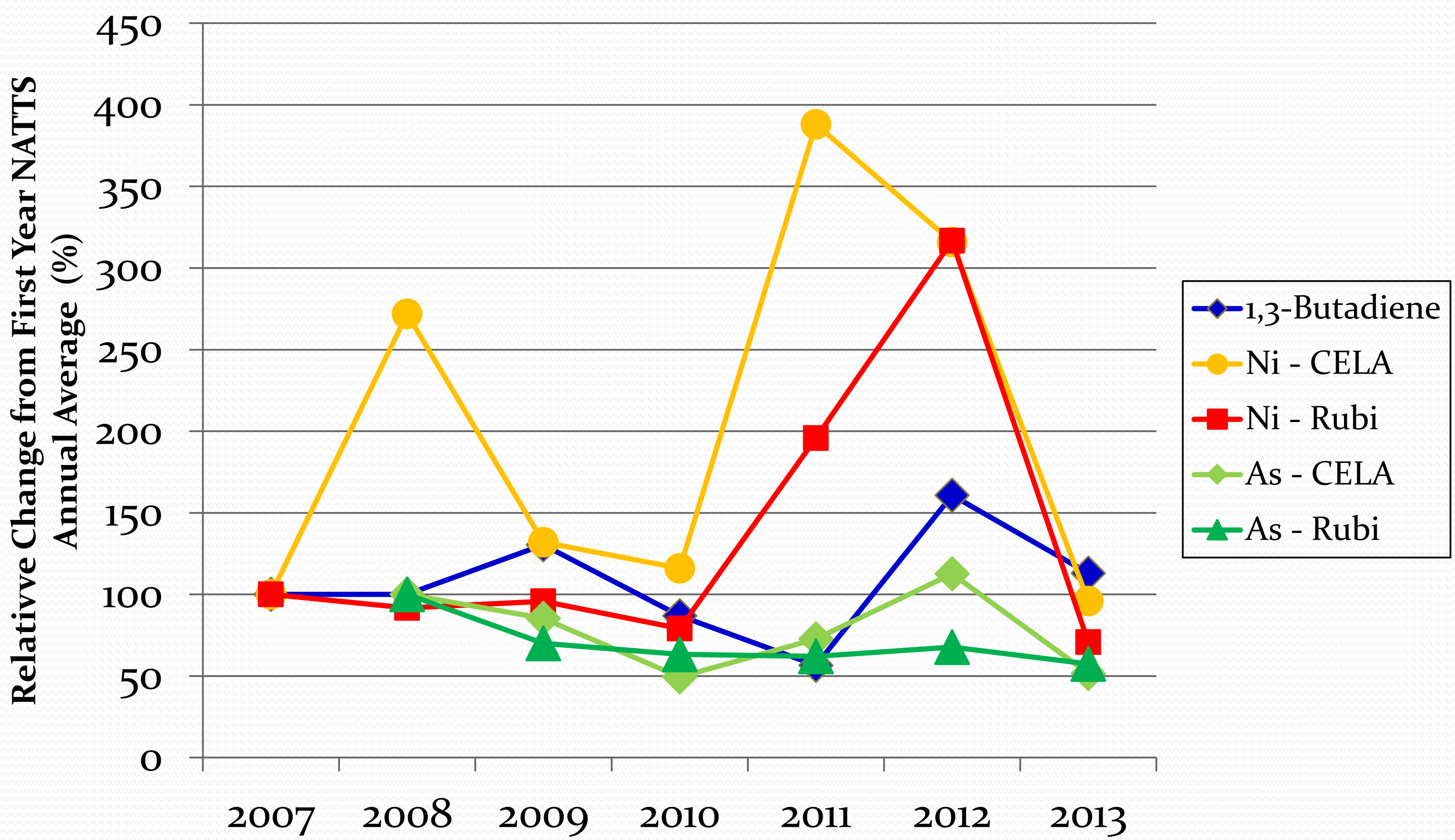
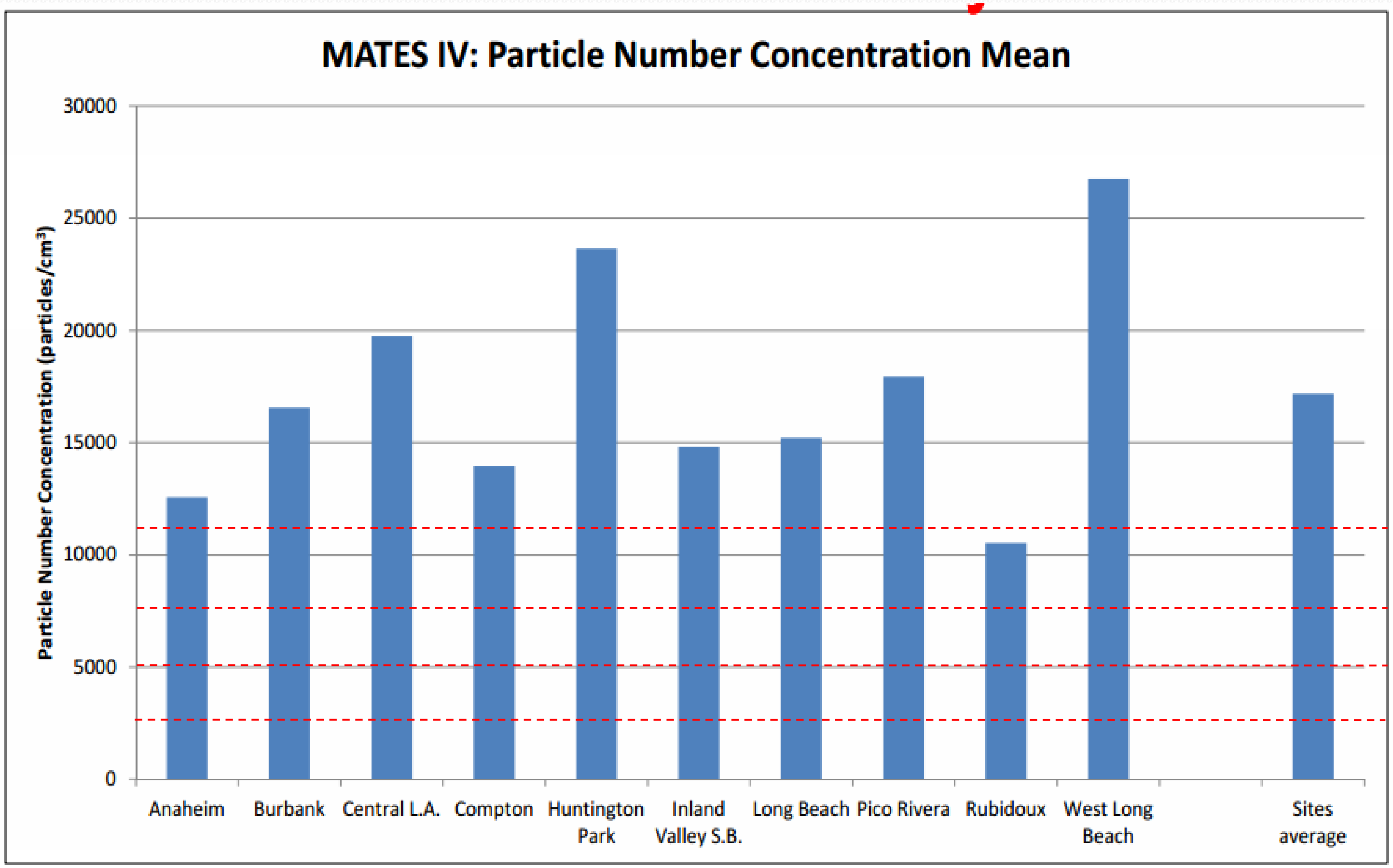


Long Term Monitoring: Ultrafine PM by Site

Road Side (~50,000 #/cm^3)

On-road (~70,000 #/cm^3)

Tunnel (~170,000 #/cm^3)



Reference UFP levels are from 2012 AQMP (Chapter 9)

Urban

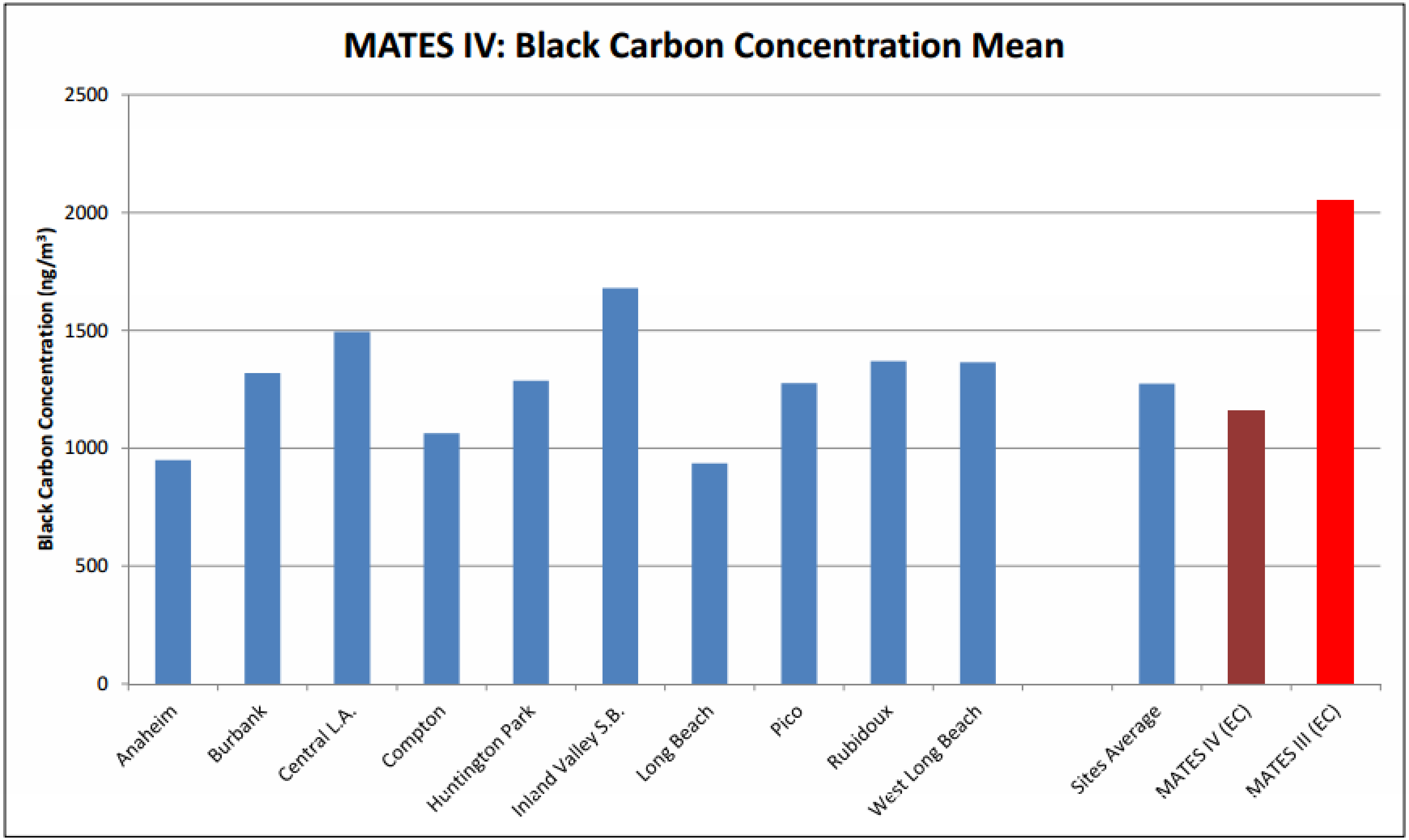
Urban Background

Rural

Clean Background

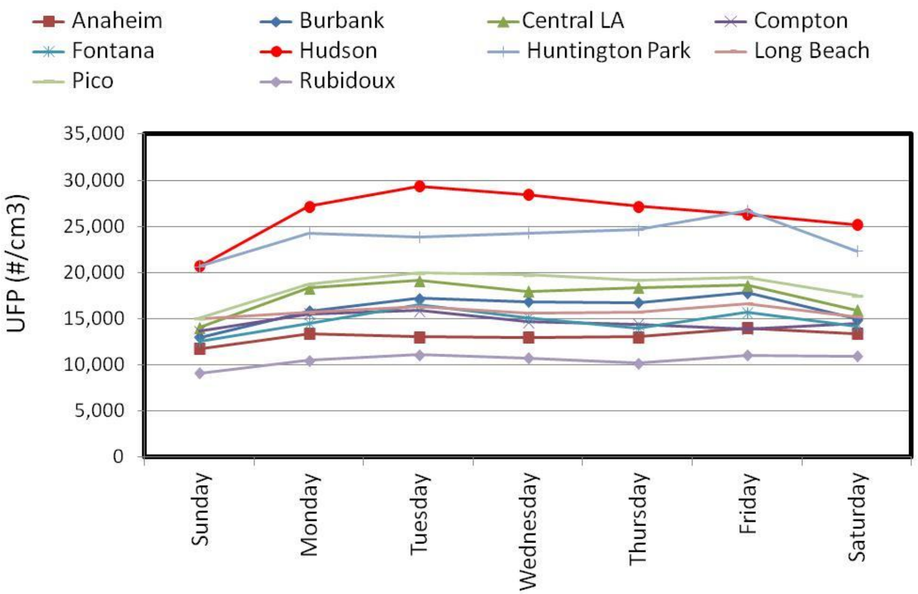
- Wide spatial variability

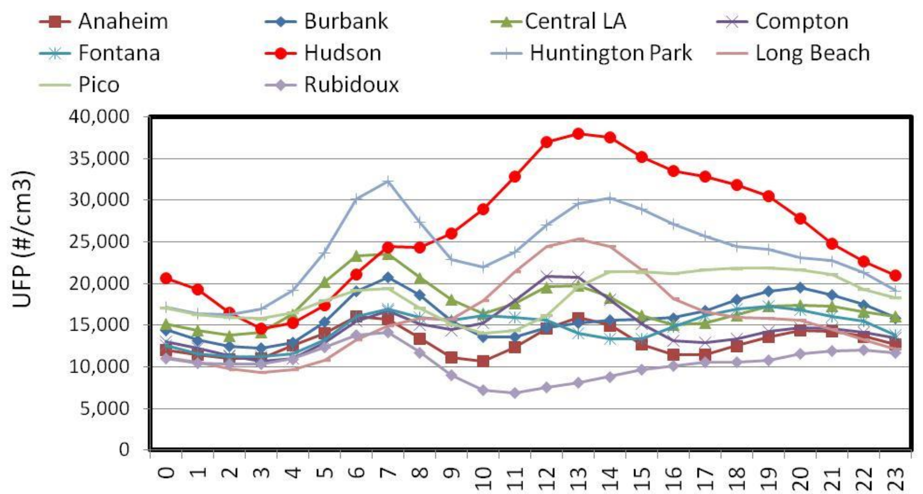
Long Term Monitoring: BC by Site

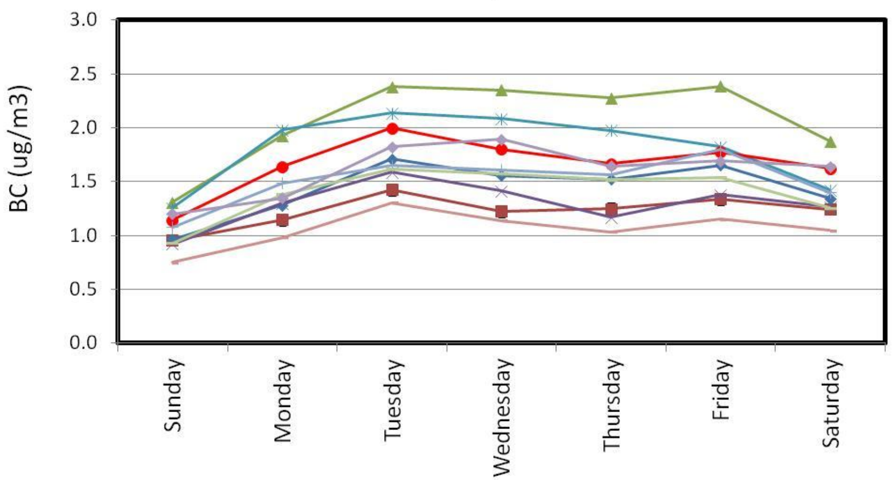


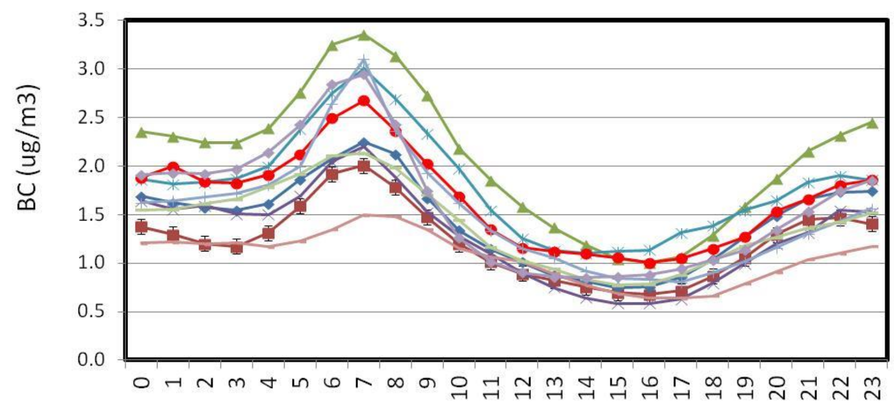
- Different spatial profile than UFP

Long Term Monitoring
Day of the Week & Time of the Day



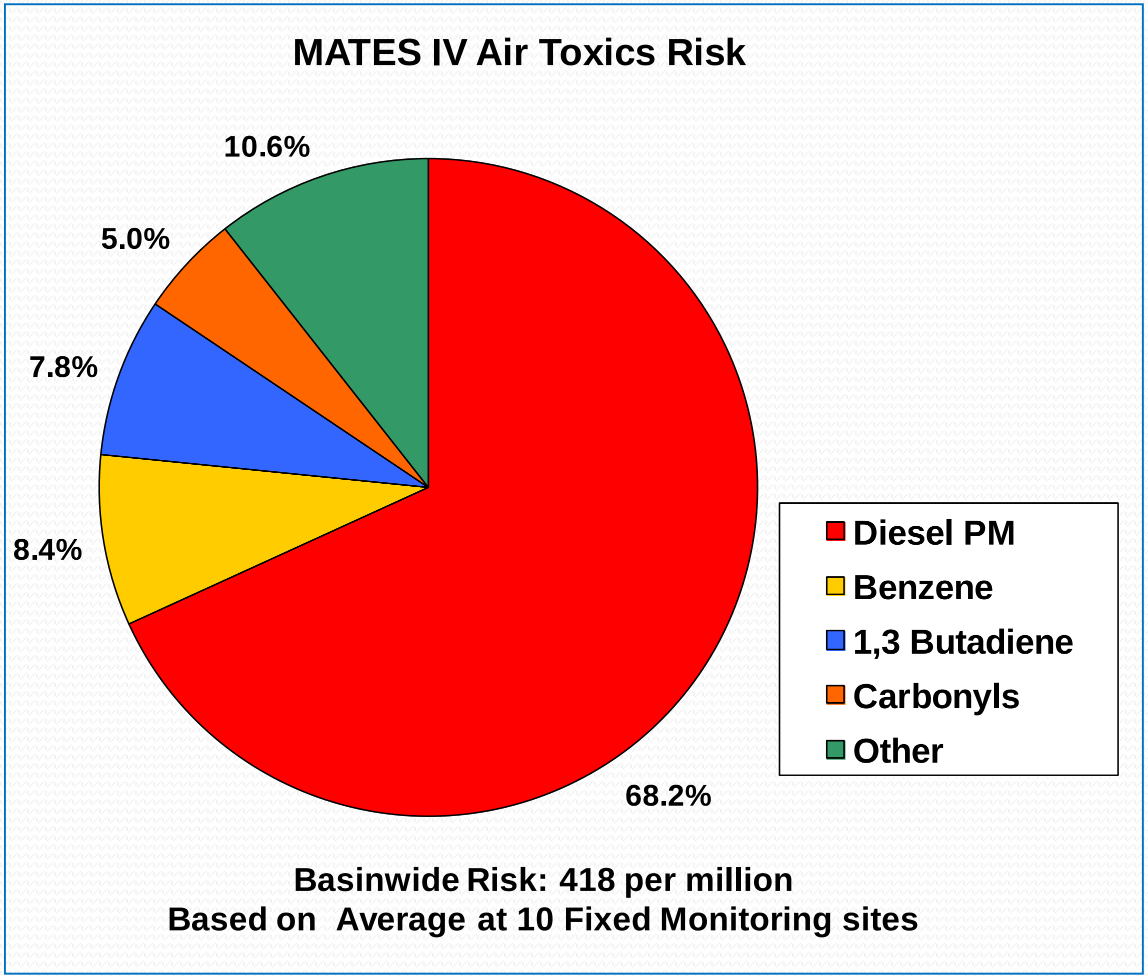




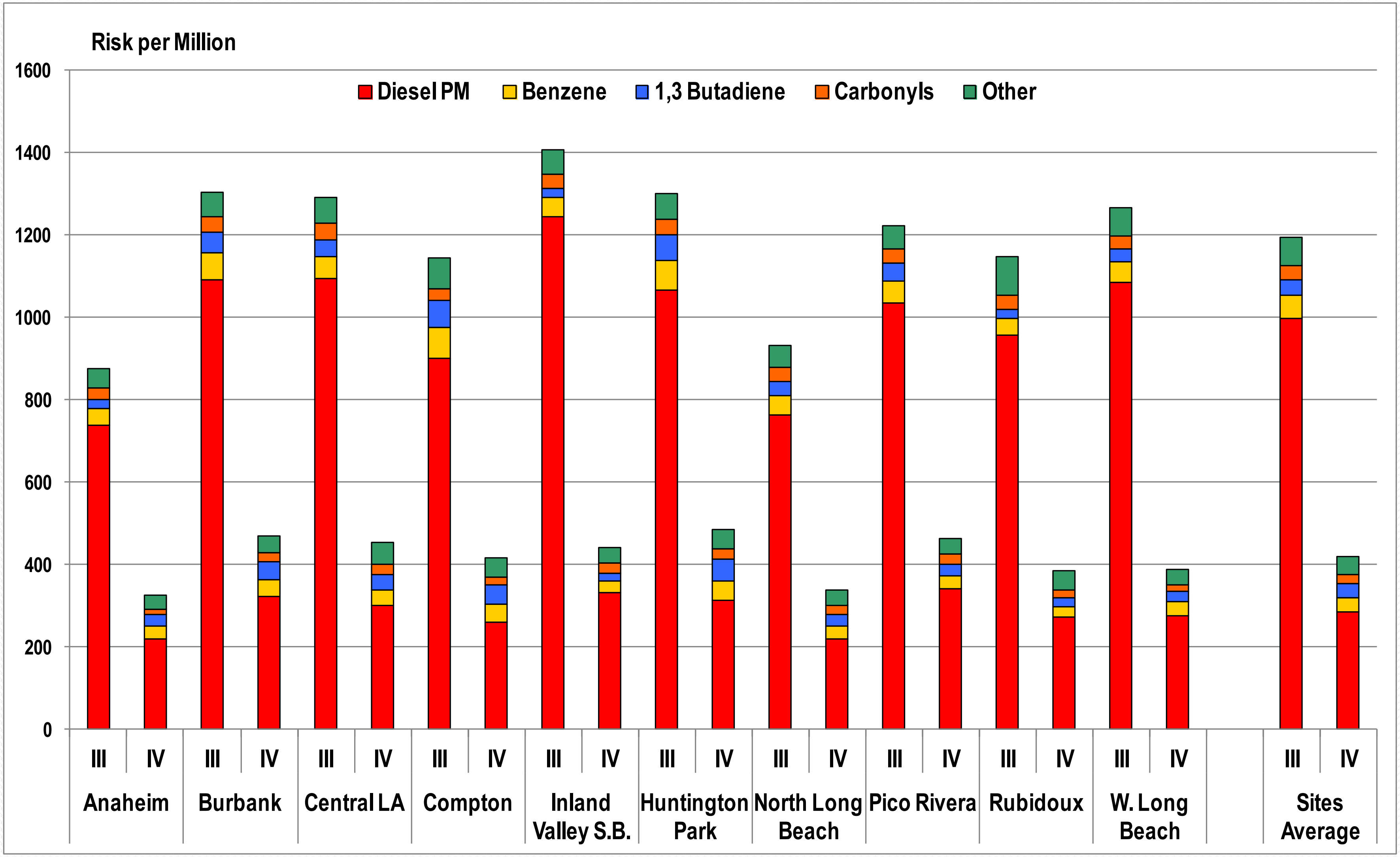


MATES IV Monitored Air Toxics Risk

- Estimated basin wide lifetime air toxics risk 418 per million
- 65% overall risk reduction from MATES III based on monitoring
- Mobile sources account for 90% of air toxics risk
- Diesel accounts for 68% of air toxics risk

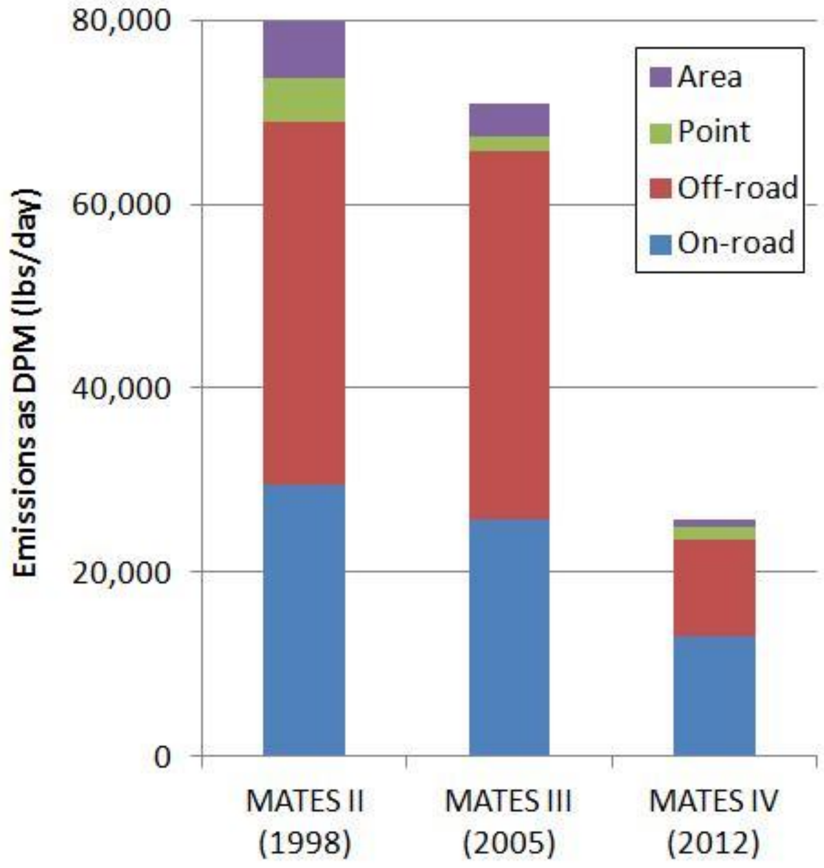


Monitored Air Toxics Risk by Site: MATES III vs. IV



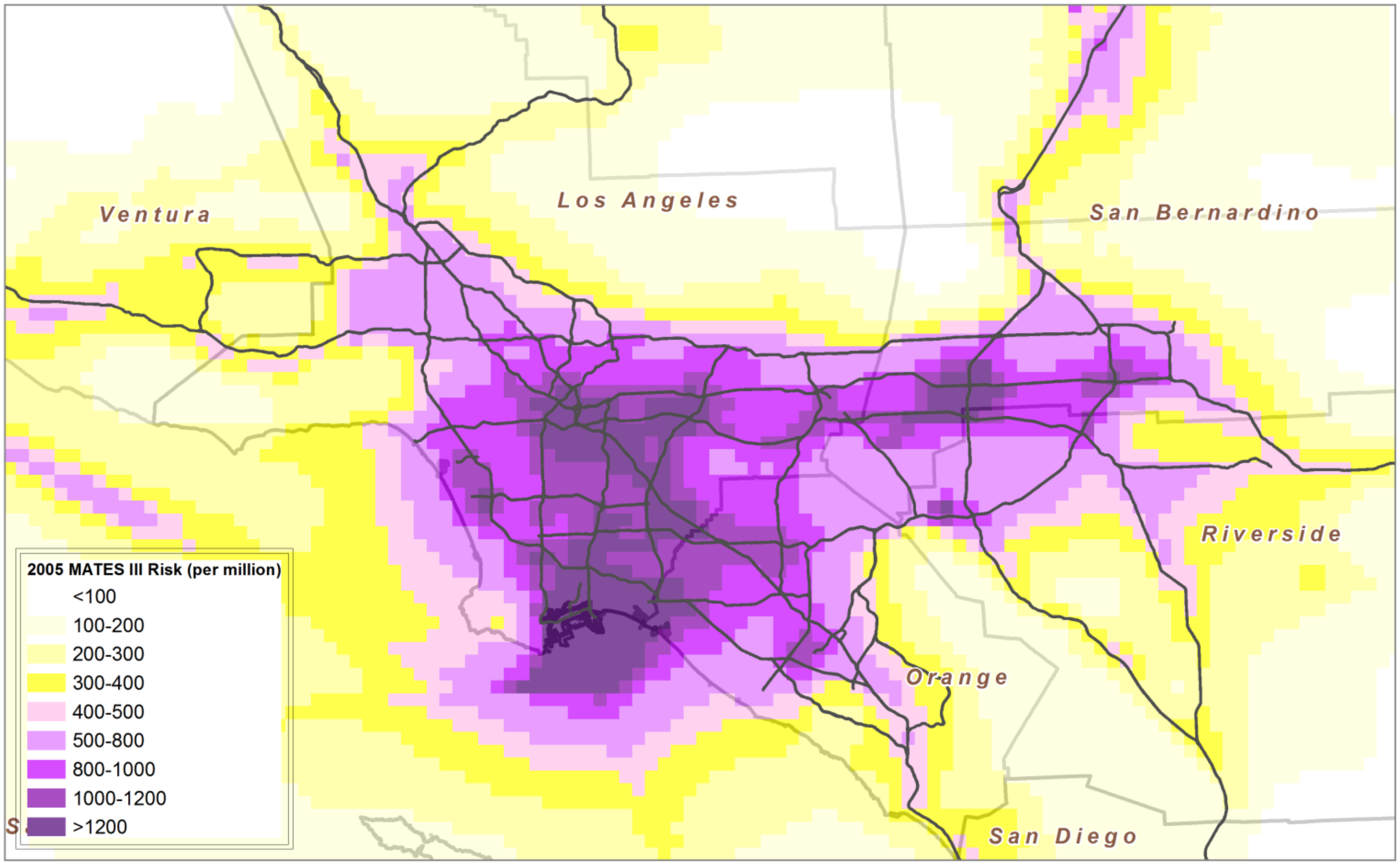
MATES IV Inventory-Based Risk Reductions

(potency weighted)

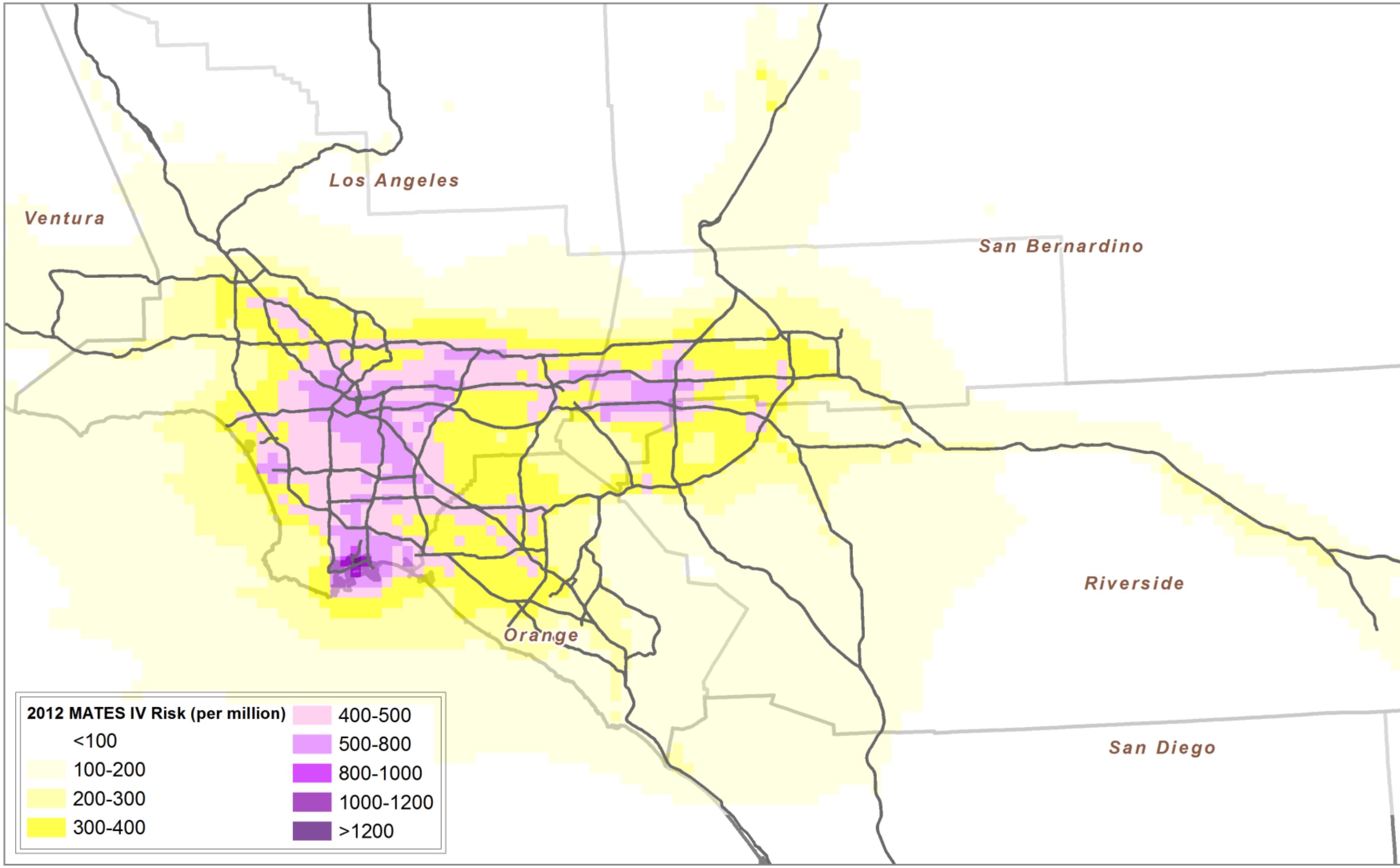


Category	Change from MATES III (%)	Change from MATES II (%)
Area	-77.5	-87.0
Point	-20.8	-72.8
Off-road	-73.5	-73.2
On-road	-49.4	-55.7

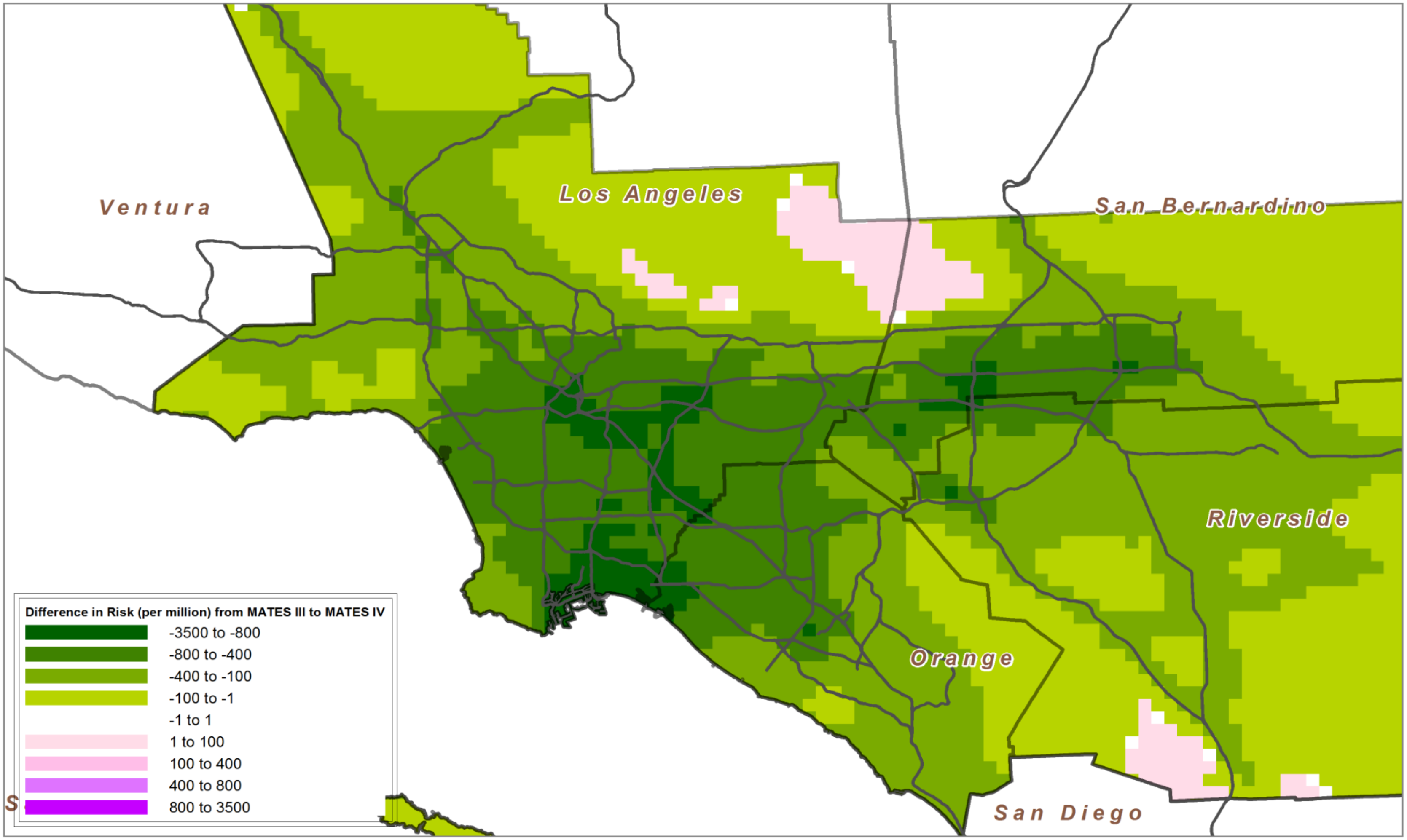
MATES III Modeled Air Toxics Risk



MATES IV Modeled Air Toxics Risk



Modeled Risk Difference: 2005 to 2012

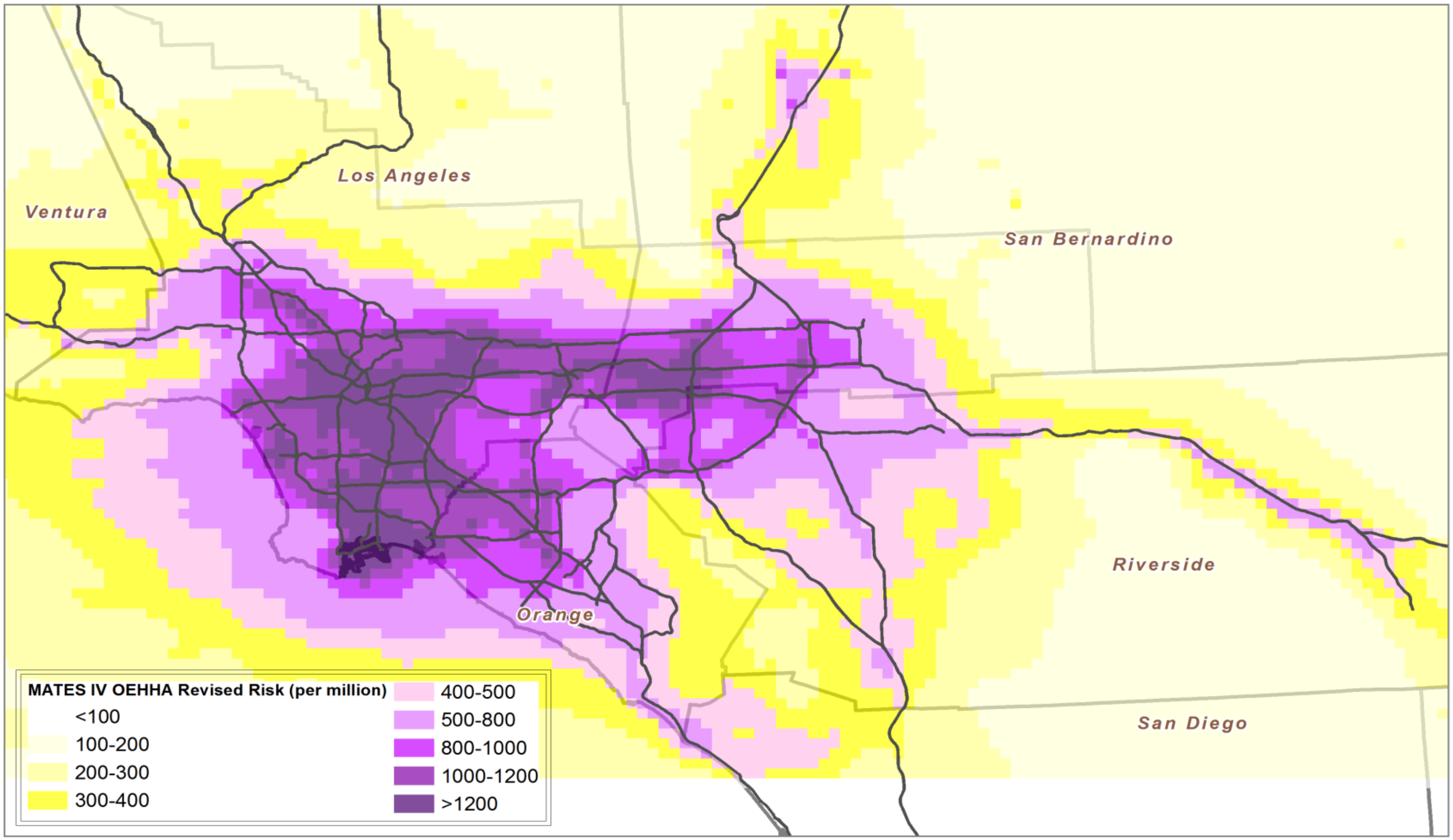


CAVEAT

CA Office of Environmental Health Hazard Assessment Updated Risk Assessment Methodology

- Considers childhood susceptibility to carcinogen exposure
- Updates age-specific breathing rates
- Reduces residential exposure period from 70 to 30 years
- Net effect:
  - Calculated inhalation carcinogenic risk may increase by a factor of about 2.7 for the same exposure concentration
  - Actual exposure and carcinogenic risk still down by more than 50%

MATES IV Modeled Risk with Proposed OEHHA Methodology



Inhalation Risks go up by factor of about 2.7

Summary/Policy Implications

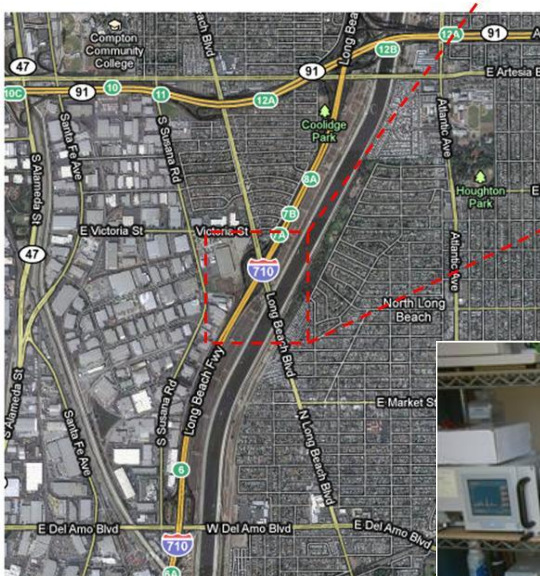
- Continued and substantial progress in reducing exposure to air toxics
- Residual risks from air toxics still unacceptably high, and higher than we previously estimated given the revised OEHHA methodology
- Diesel particulate exposure substantially reduced, but still the major contributor to air toxics risk, concentrated near ports and transportation corridors
- Importance of continued reduction in mobile source emissions in order to achieve toxics reductions and federal standards

Next Steps

- Final Report:
  - SCAQMD Webpage: http://www.aqmd.gov/home/library/air-quality-data-studies/health-studies/mates-iv
- MATES V

Additional Slides

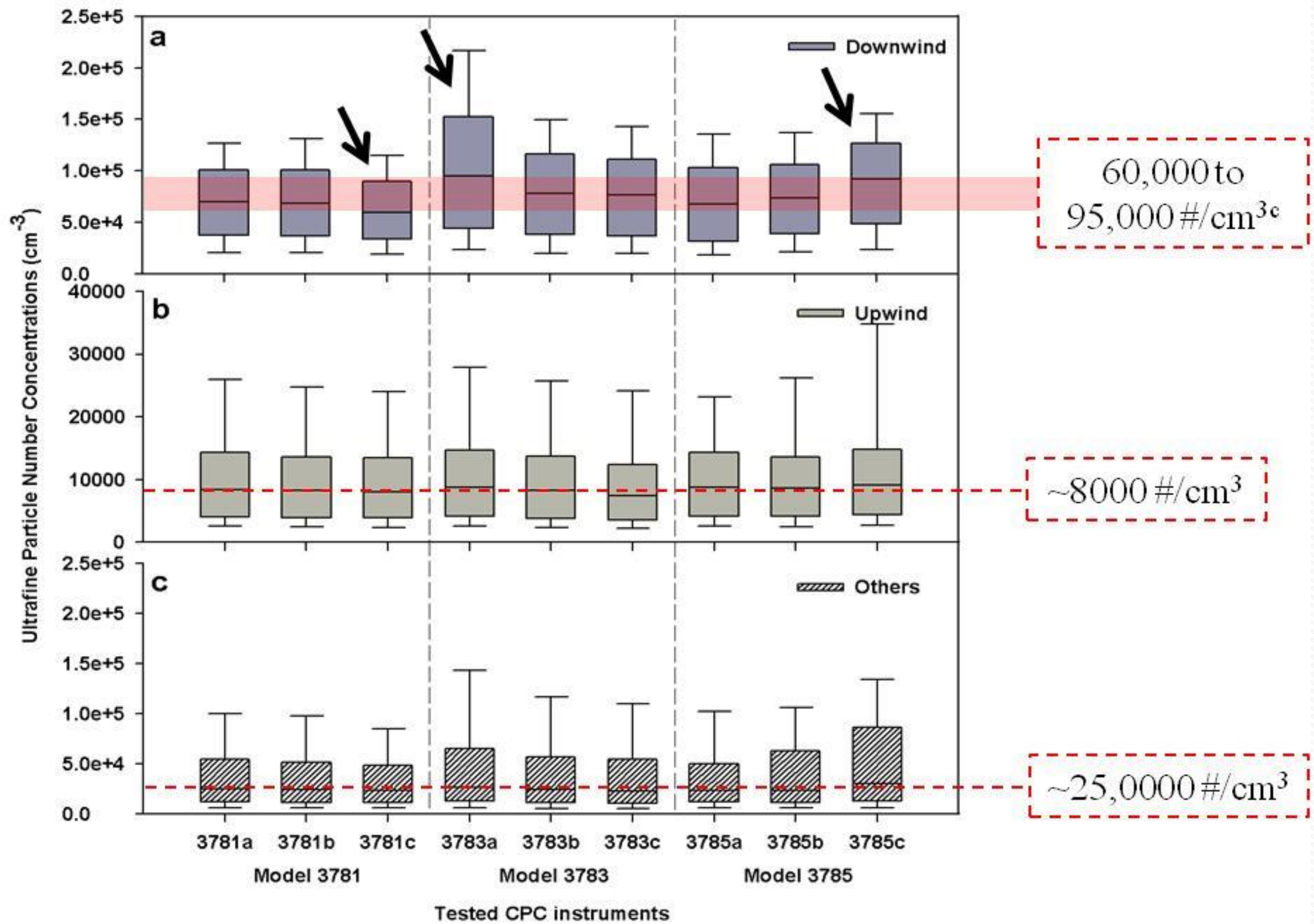
Pre-MATES IV Instrument Evaluation (Ultrafine PM)



- Water-based Condensation Particle Counters (CPCs)
  - ➢TSI models 3781, 3783, and 3785 (three units per model)
  - ➢CPCs from other manufacturers also tested
- Size distribution (SMPSs)
- Meteo data
- Traffic information

Specifications	Model 3781	Model 3783	Model 3785
Detectable Particle Diameter Ranges	6 nm to 3 μm	7 nm to 3 μm	5 nm to 3 μm
Time Resolution	1 min	1 min	1 min
Maximum Detectable Particle Concentrations (cm^{-3})	5×10^5	1×10^6	1×10^7
Particle Counting Errors	± 10 % at 5×10^5 cm^{-3}	± 10 % at 1×10^6 cm^{-3}	± 10 % at 2×10^4 cm^{-3}
Aerosol Flow Rates (L/min)	0.12 ± 0.012	0.12 ± 0.012	1.0 ± 0.1
Inlet Flow Rates (L/min)	0.6 ± 0.12	3 ± 0.3	1.035

Pre-MATES IV Instrument Evaluation (Ultrafine PM)

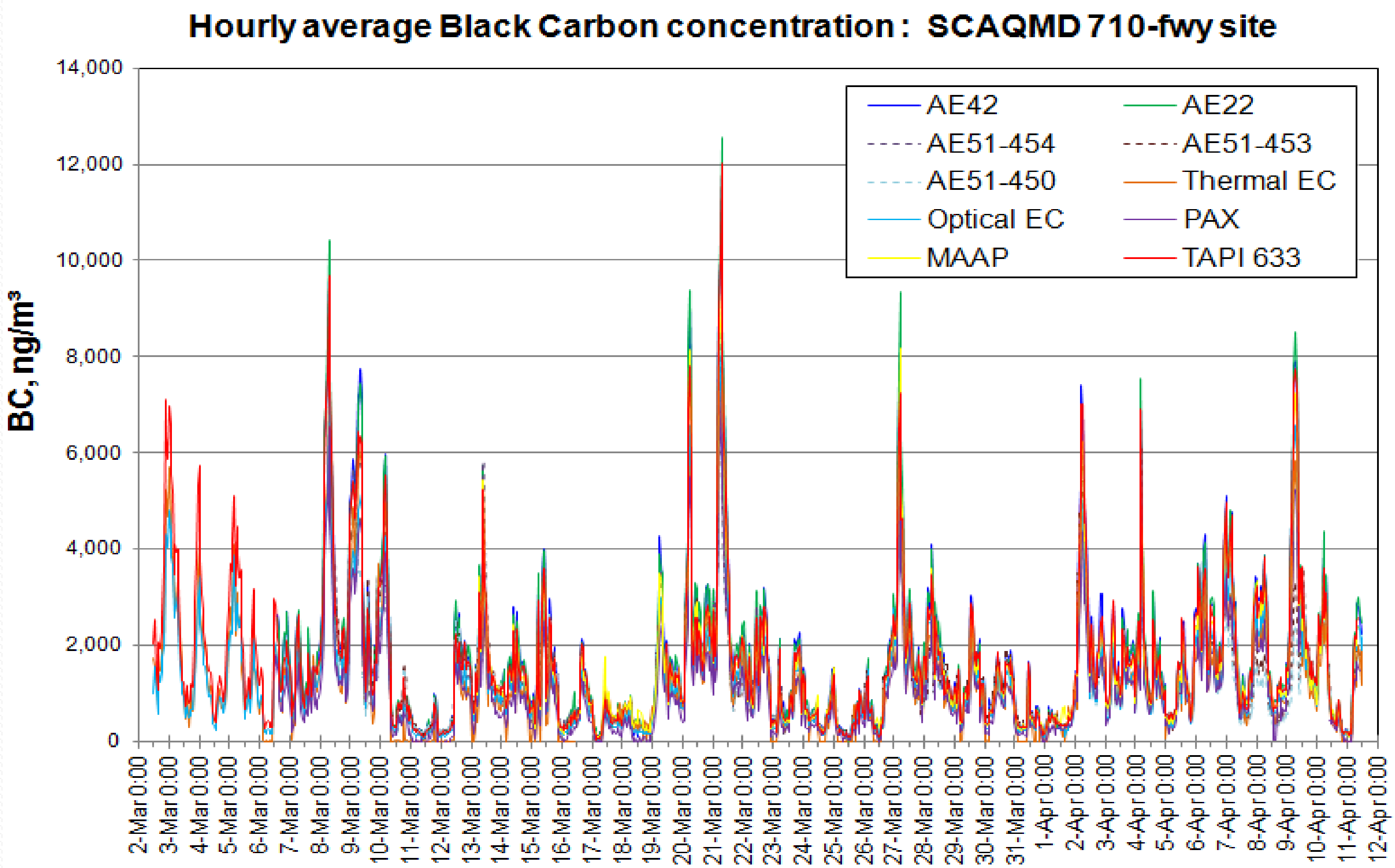


Lee, E. et al. (2013) "Water-based condensation particle counters comparison near a major freeway with significant heavy-duty diesel traffic", Atmospheric Environment, 68: 151-161

Pre-MATES IV Instrument Evaluation (BC and EC)

- Athelometer: http://mageesci.com/
  - Dual-channel
  - Portable
  - Micro
- Photoacoustic Extinctiometer (PAX): http://www.dropletmeasurement.com/products/carbon-sensing-instruments.html
- Semi-continuous carbon analyzer: http://www.sunlab.com/
- Multiangle Absorption Photometer (MAAP): http://www.mlu.at/index.php?gr_id=66&k_id=506&b_id=&gp=&at=238
- Integrated filter samples for EC

Pre-MATES IV Instrument Evaluation (BC and EC)



Pre-MATES IV Instrument Evaluation (BC and EC)

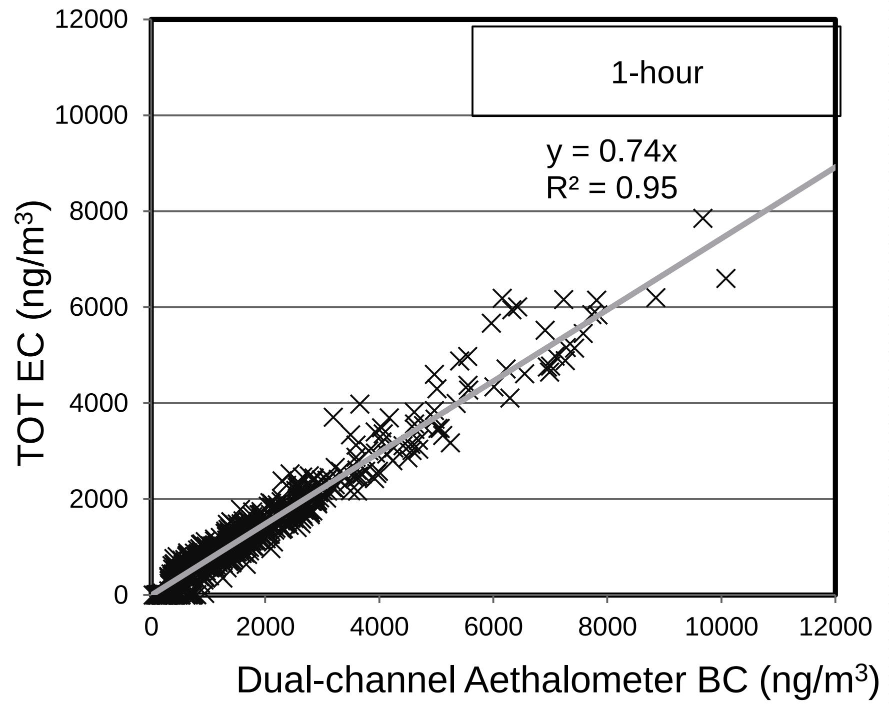
- Both measurements are operationally defined
- Very strong correlation - slopes can be adjusted

Correlation Coefficient (R^2)

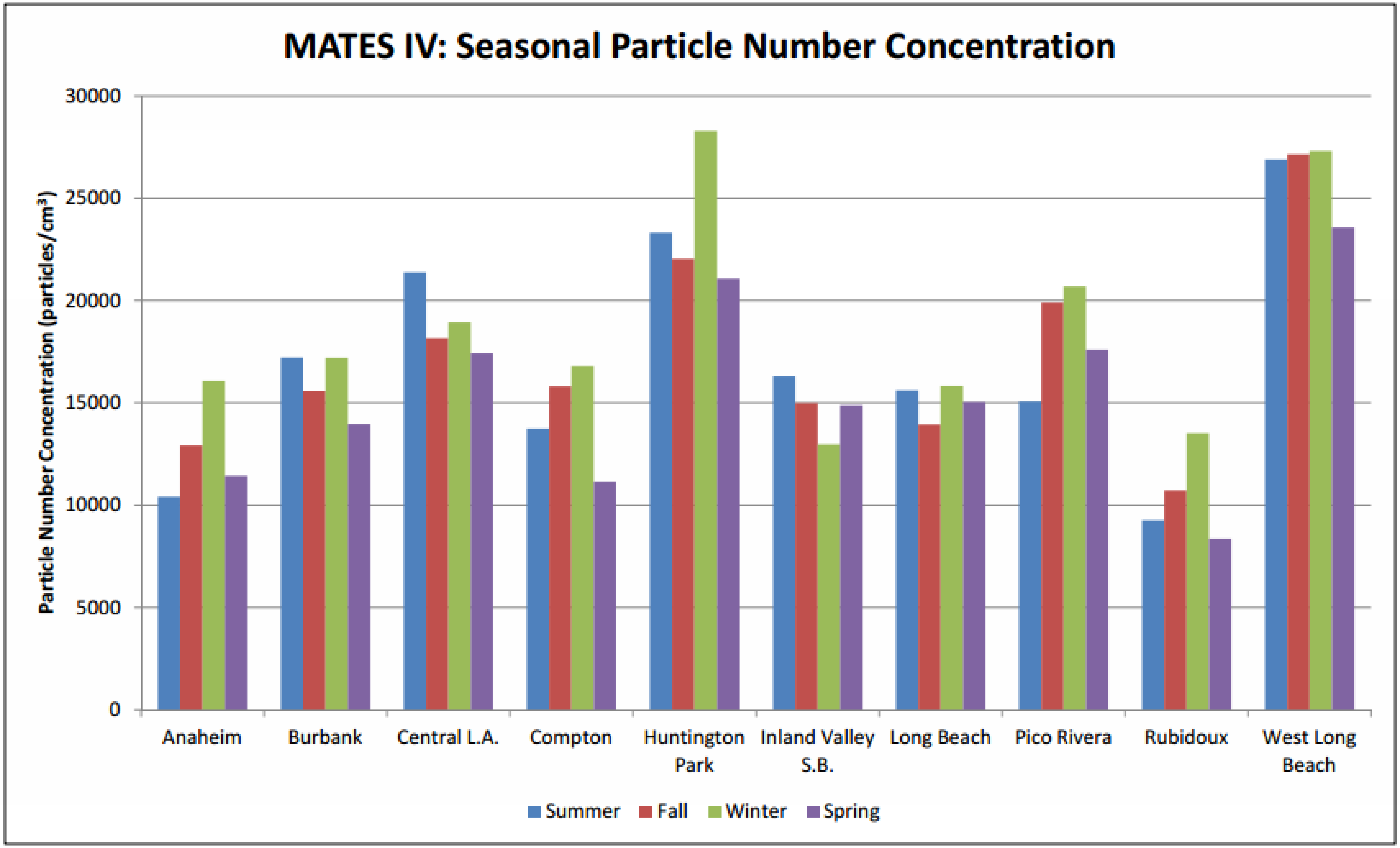
^ X ^	Legacy Aeths	Thermal EC	Optical EC	PAX	MAAP < Y
633	0.99	0.95	0.96	0.98	0.98
Legacy Aeths		0.95	0.98	0.98	0.99
Thermal EC			0.94	0.95	0.95
Optical EC				0.96	0.98
PAX					0.97

Slope

^ X ^	633	Legacy Aeths	Thermal EC	Optical EC	PAX	MAAP < Y
633		1.08	0.80	0.79	0.70	0.93
Legacy Aeths	0.93		0.75	0.76	0.66	0.87
Thermal EC	1.26	1.34		1.04	0.92	1.28
Optical EC	1.26	1.32	0.96		0.89	1.13
PAX	1.43	1.52	1.09	1.13		1.35
MAAP	1.07	1.15	0.78	0.89	0.74	

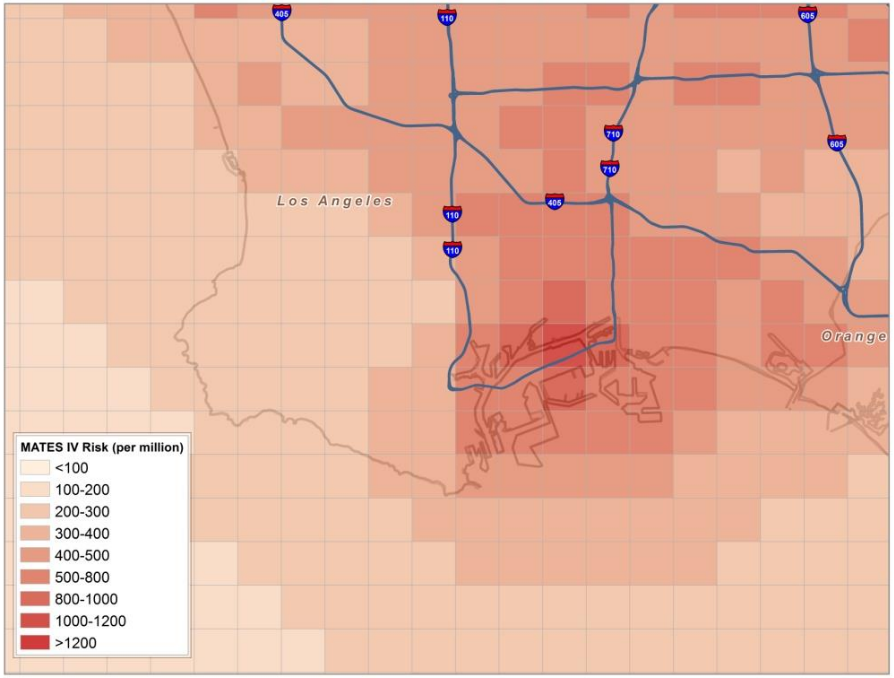


Long Term Monitoring: Ultrafine PM by Season



Basin and Port Area Population-Weighted Modeled Cancer Risk

Highest Grid Cell Risk 1,057



Region	MATES IV		MATES III		Average Percentage Change in Risk
	2012 Population	Average Risk (Per Million)	2005 Population	Average Risk (Per Million)	
Basin	15,991,150	367	15,662,620	853	-57
Ports Area	998,745	480	959,761	1,415	-66
Basin Excluding Ports Area	14,992,806	359	14,702,859	816	-56