

Black Carbon in the South Coast Basin

*Emissions, Measurements, and Modeling in the
MATES Studies*



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BLACK CARBON SYMPOSIUM
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Theme



- Detailed regional emissions inventories, modeling and measurements are being conducted
 - *PM_{2.5} NAAQS attainment planning*
 - *Air Toxic Exposure Assessments (MATES)*
- These necessarily include PM speciation
 - *Elemental Carbon (EC) as a component of PM_{2.5}*
 - *Elemental Carbon (EC) as an indicator of Diesel PM toxic risk*
- How can these results or methods inform the effort assessing the climate impacts of Black Carbon?

Studies Related to EC/BC in South Coast



- Multiple Air Toxics Exposure Study (MATES)
 - *Year-long monitoring program*
 - *Complete emissions inventory of air toxics*
 - *Gridded regional model to characterize toxic risk*
 - *Diesel Particulate Matter considered an air toxic in CA*
 - *EC measurements help quantify diesel PM*
- Permanent EC measurements at PM_{2.5} speciation sites (4)
- Community or source-oriented studies
- EC/BC methods and instrumentation comparisons

MATES Studies

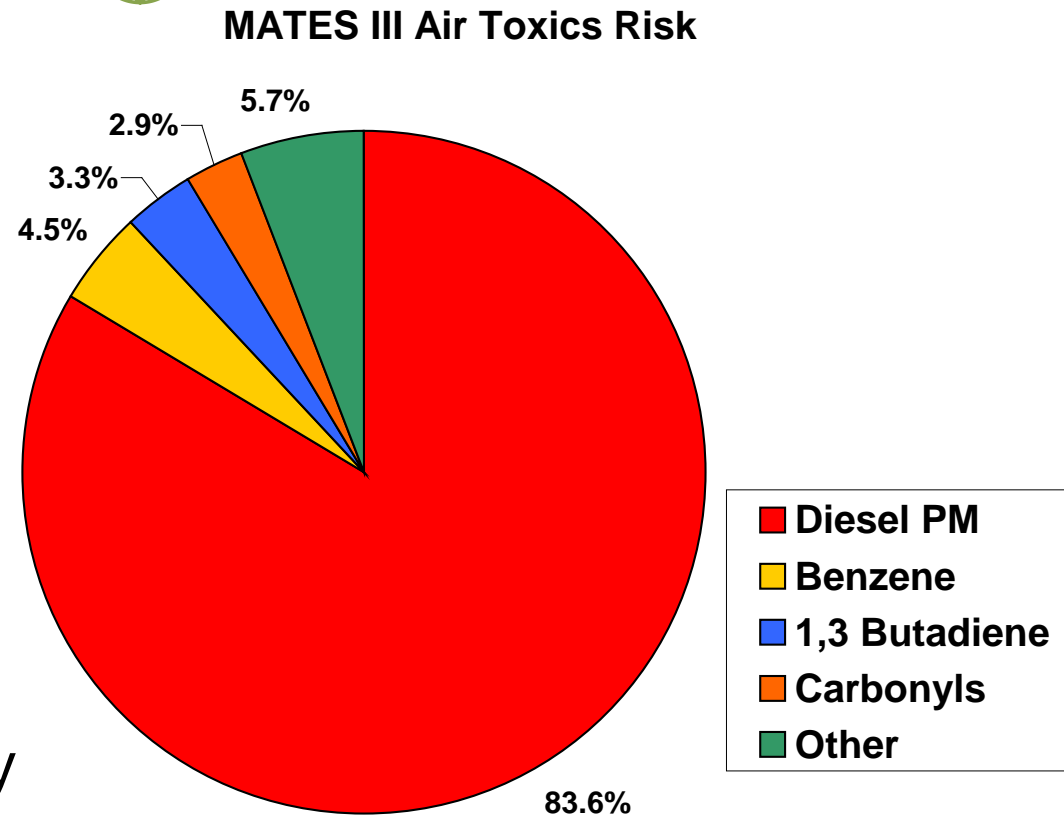


- MATES I conducted in 1987
- MATES II conducted 1998-99
 - *Downward trend for certain air toxics*
 - *Diesel exhaust - 71% of cancer risks from air toxics*
- MATES III conducted 2004-2006
 - *Continuing downward risk trend, other than Diesel PM*
 - *Diesel PM risk up near ports*
 - *Enhanced Diesel PM quantification methods*
 - *Hexavalent chromium from cement plants*
- MATES IV Summer 2012 to 2013
 - *Adding Black Carbon (BC) and ultrafine particle measurements*
 - *Local-scale mobile source impact monitoring*

MATES III Monitoring Estimated Risk



- General trend is down for air toxics risk
- Estimated basin wide lifetime risk 1,200 per million
- Mobile source toxics account for 94% of risk
- Diesel accounts for 84% of air toxics risk
- Non-diesel risk lower by 50% from MATES II

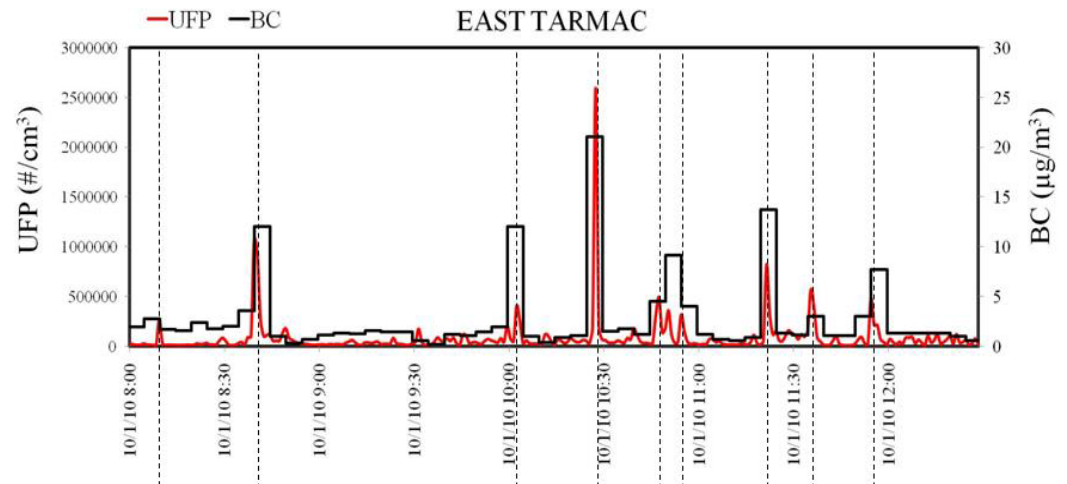
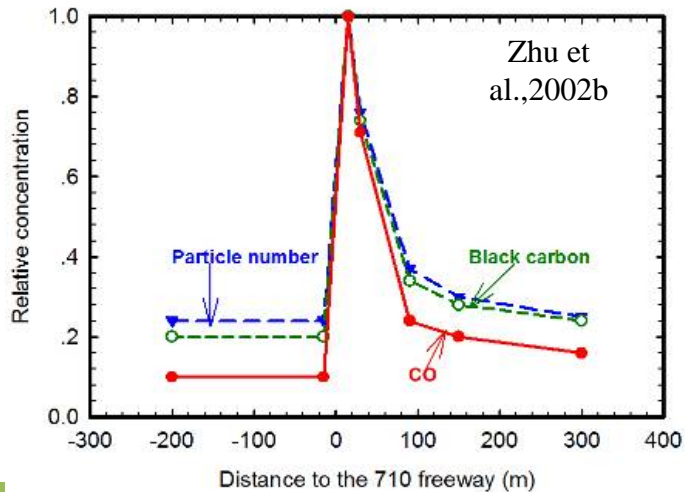


Basinwide Risk: 1194 per million
Based on Average at Fixed Monitoring sites

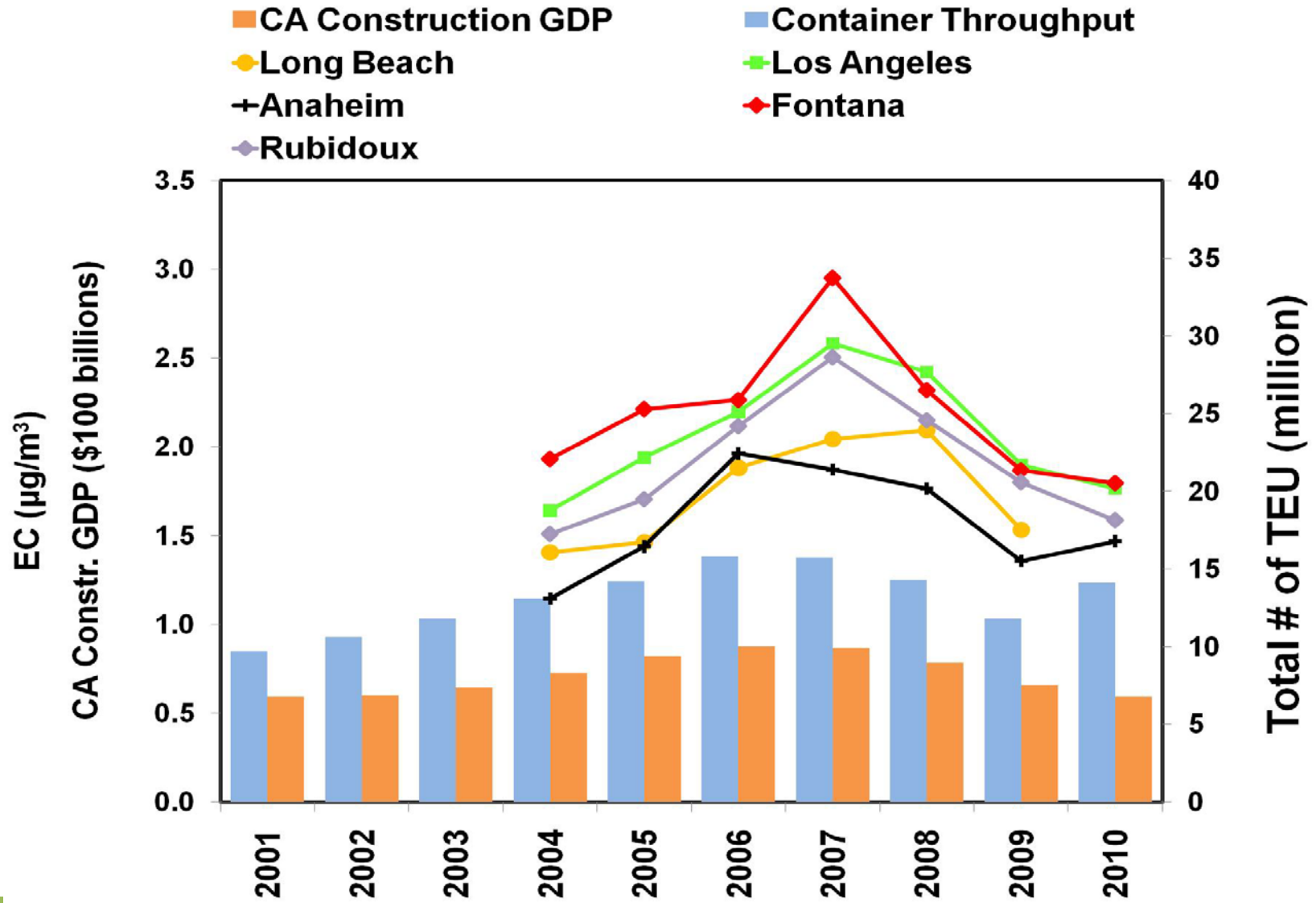
Local Health Impacts



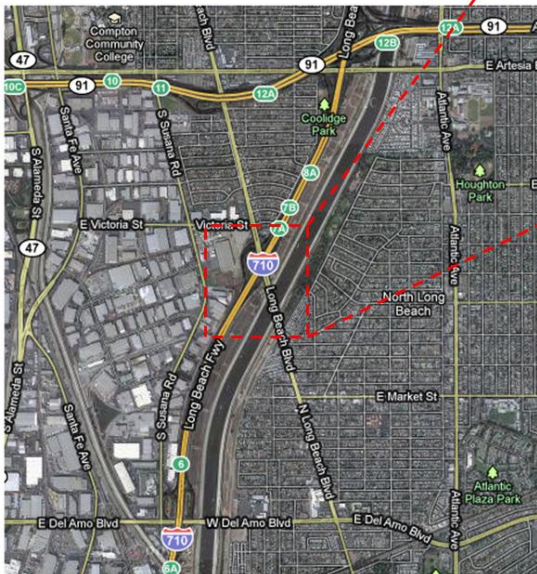
Wind



EC Trends



I-710 BC Instrument Comparison



BC/EC instruments

- Athelometer: <http://mageesci.com/>
 - Dual-channel
 - Portable
 - Micro
- Photoacoustic Extinctionmeter (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

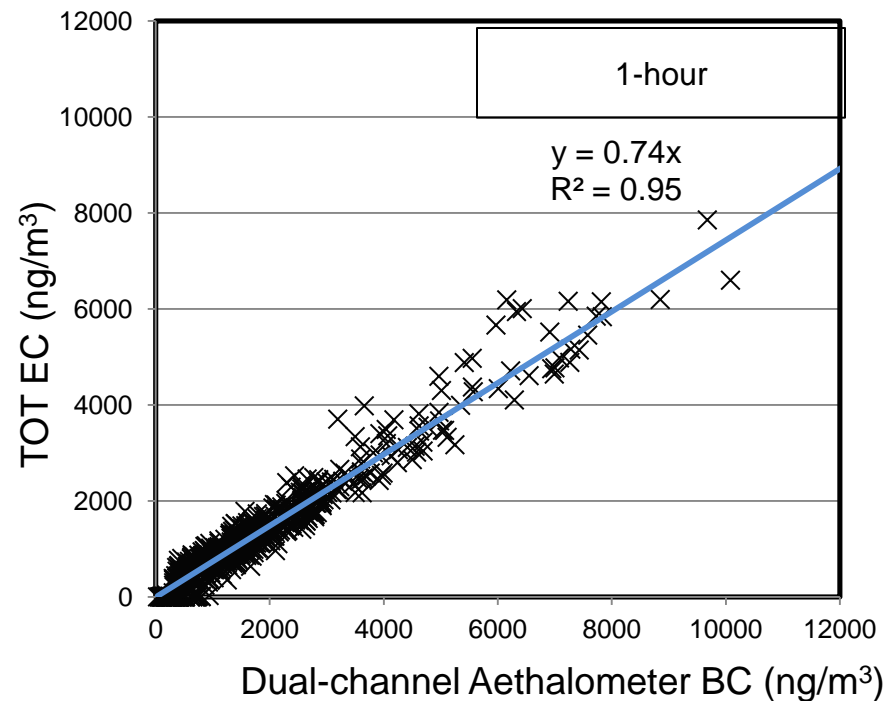
Black Carbon vs. Elemental Carbon



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

Correlation Coefficient r^2

	Legacy Aeths	Thermal EC	Optical EC	PAX	MAAP
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



EC Emissions Inventory



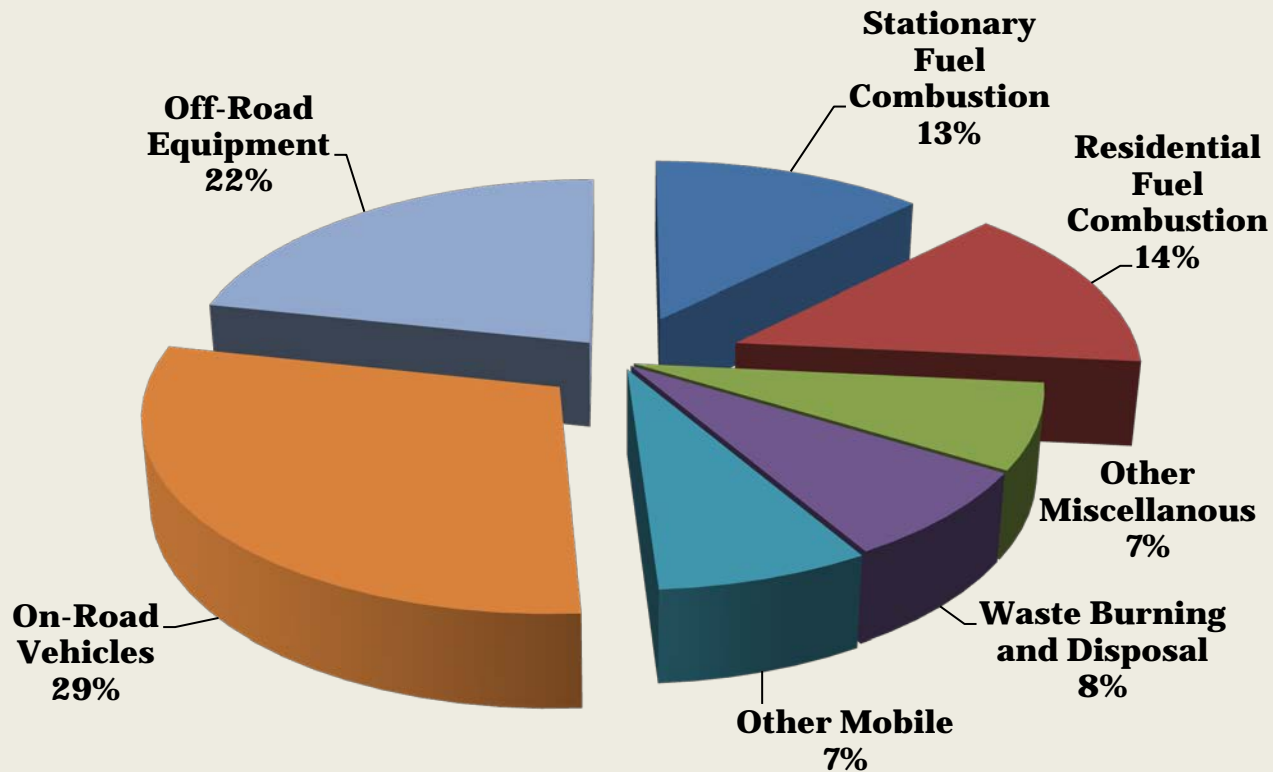
Methodology

- Inventory based on PM2.5 SIP baseline year
 - *Point source emissions from Annual Emissions Reports*
 - *On-road and off-road emissions provided by CARB in EMFAC on off-road models*
- Growth factors applied to sources for future years
 - *Growth factors for economic activity, VMT mostly provided by SCAG*
 - *Rule factors developed by SCAQMD staff*
- EC emissions estimated using PM2.5 speciation profiles (CARB database www.arb.ca.gov/ei/speciate/interopt10.htm)

MATES III EC Inventory Results



Total 2005 Inventory = 28,760 lbs/day fine particulate EC



MATES III Regional Modeling



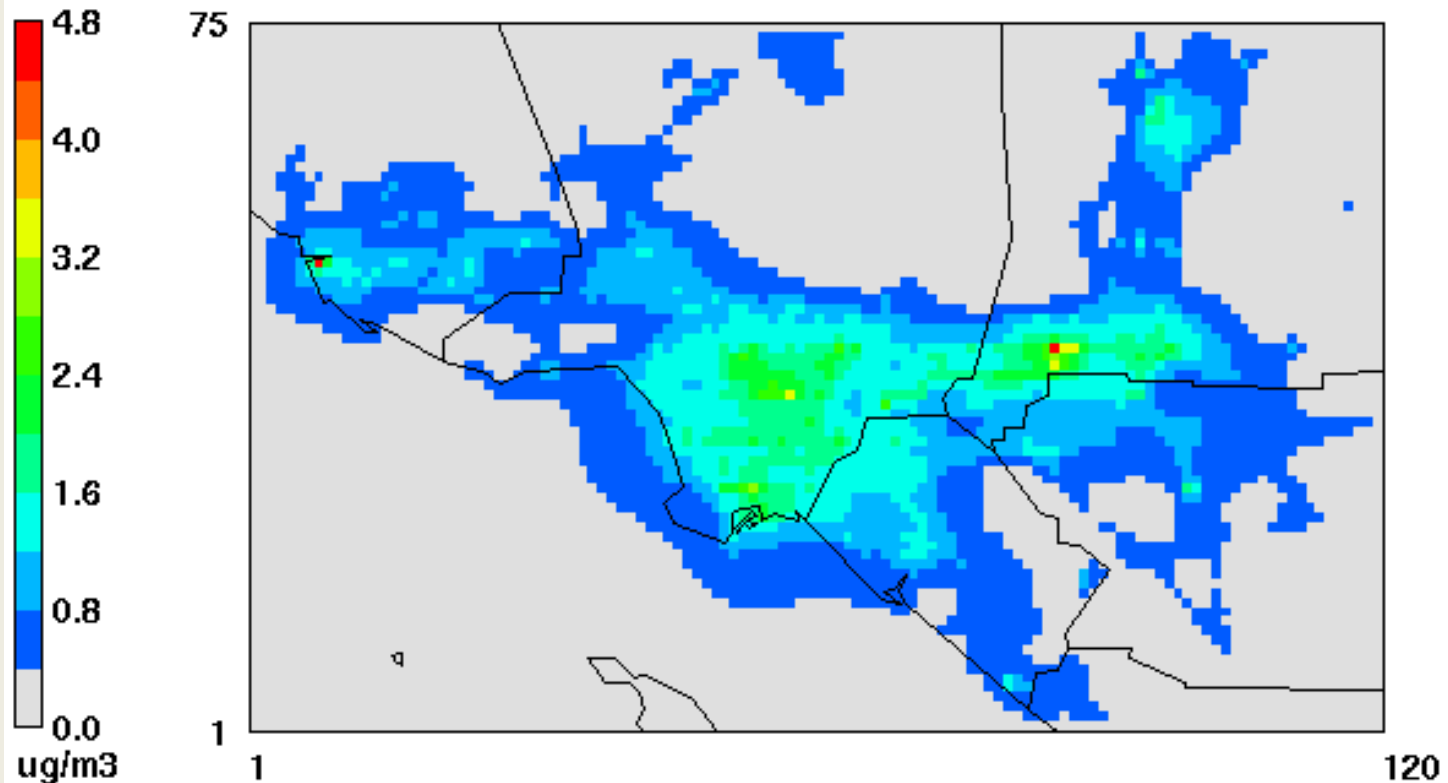
- CAMx with RTRAC (reactive tracer modeling capability)
 - *2 km by 2 km gridded inventory*
 - *Encompasses Basin and shipping lanes*
 - *Future work may use CMAQ*
- Point source emissions placed at the facility location
- Area and off-road emissions located using spatial surrogates
- On-road emissions located at link segments according to SCAG

Modeled Spatial EC

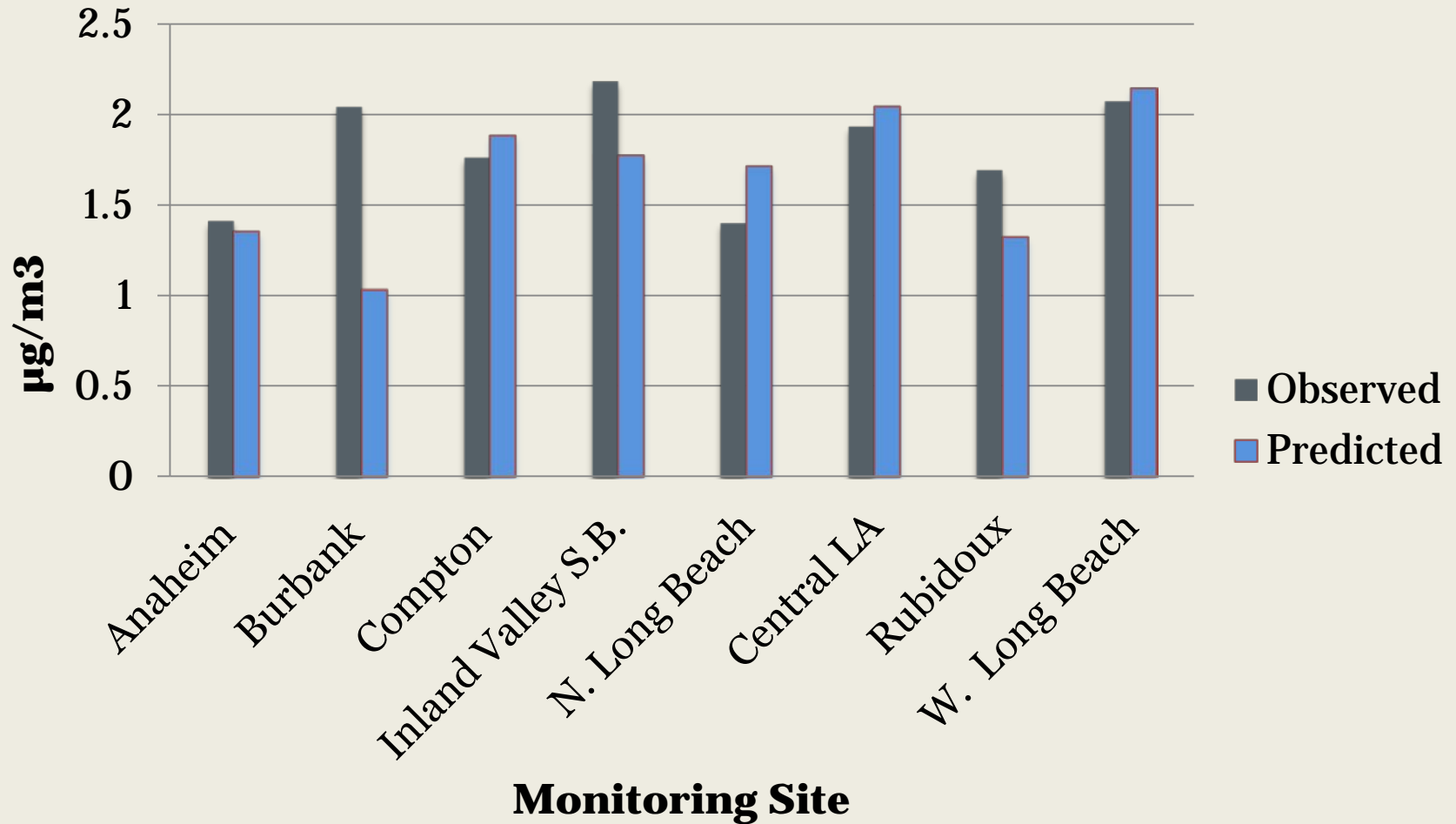


Elemental Carbon (PM2.5)

2005 Annual Average Concentrations
c=average.final.plot

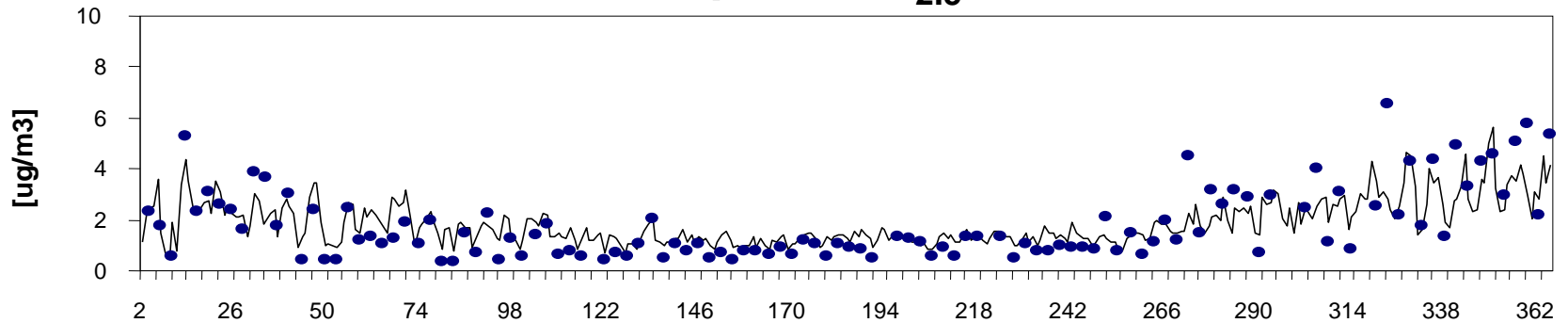


Measured and Modeled EC Comparison MATES-II 2005

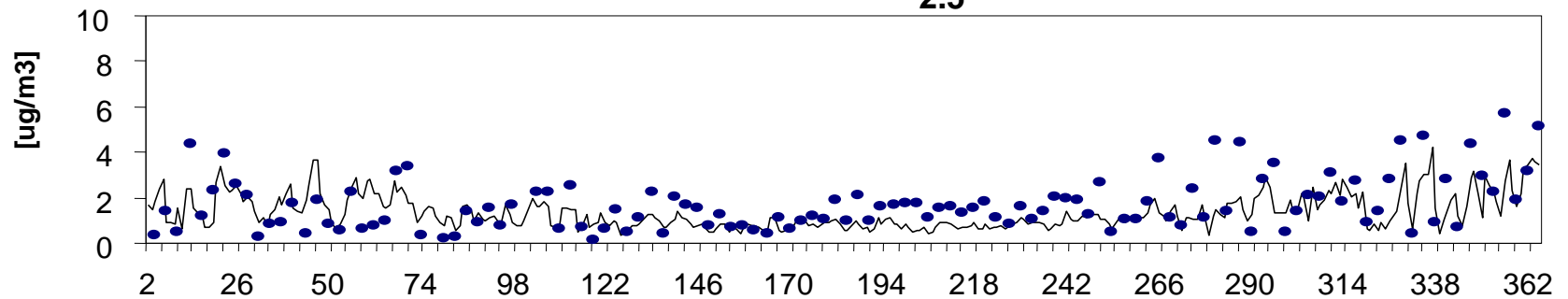


Monitoring Site Modeled and Measured

Compton EC_{2.5}

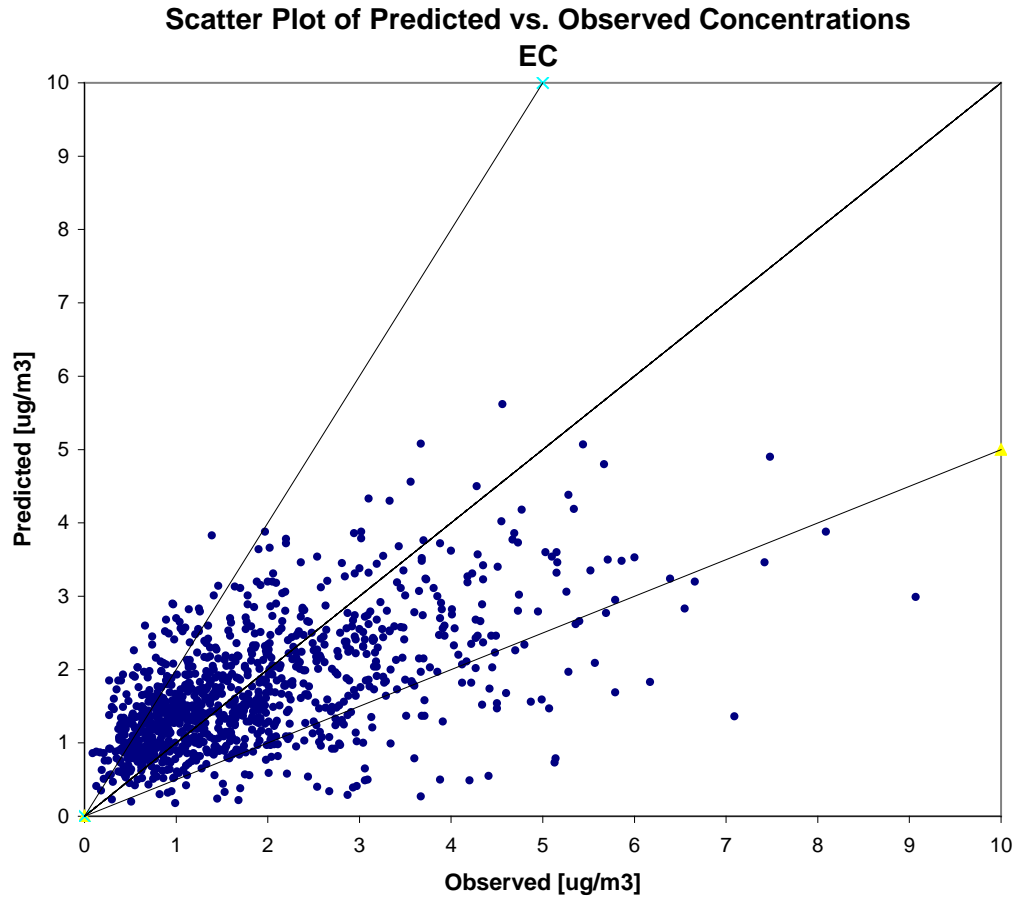


Rubidoux EC_{2.5}



● Observed — Predicted

All Stations MATES-III



Potential Future Work



- Regional model output into global model
- Determine BC particle transport, residence time, mixing state, and fate outside of the Basin
- Estimate global and local radiative forcing from Basin emissions
- Estimate climate benefit from $PM_{2.5}$ and Diesel PM control strategies
- Create conceptual framework for other areas to evaluate co-benefits of BC emissions control

