

One Atmosphere Modeling for the South Coast Air Basin

Joe Cassmassi

Senior Meteorologist

South Coast Air Quality Management District

Attainment Status

- Ozone
 - 1-Hr: extreme non-attainment (2010)
 - 8-Hrs: serious non-attainment (2021)
- PM10
 - Annual & 24-Hrs: Serious non-attainment (2006)
- PM2.5
 - Annual & 24-Hrs: Non-attainment (2015)

Environmental Justice Issues

- 1998-1999 MATES II Toxic Impact Study
- 2004-2006 MATES III
 - Monitoring and analyses ongoing
 - Study scope expanded from MATES II
 - Updated emissions (point and mobile)
 - Updated meteorology
 - Annual modeling for deposition and risk
- Alameda Corridor sub-regional analysis
- Possible revision to Regional Toxic Control Plan

Planning Requirements

- PM2.5 SIP required by November 2007
- Ozone SIP required By November 2008
- Joint Air Quality Management Plan (AQMP) for 2007 submittal
- Draft AQMP release summer 2006
- MATES III Final Report with regional modeling scheduled for summer 2006

Collision Course or Window of Opportunity?

- Multiple modeling scenarios
- Annual and short-term simulations
- Multiple modeling platforms and chemical mechanisms
- Vast archives of meteorological data
- Varying computational turn-around times
- Data storage requirements
- Short-fuse analysis and reporting

SS SCAQMD Modeling and Meteorology Section



Southern California Partners

- Primary
SCAQMD & CARB Modeling
- Secondary
San Diego (with consultant)
- Other end users
Ventura County
Santa Barbara
Mojave Desert
Imperial County
US Navy – Pt. Mugu

2003 AQMP

- Simulated episodic ozone
 - 1-hr standard for 2010
 - 8-hr standard for 2010
- Simulated annual average particulate
 - 2006 attainment PM10 demonstration
 - PM2.5 for 2006 and 2010
- Estimation of additional emissions reductions needed to reach 8-hr ozone and pm2.5 standards

2003 AQMP Modeling Advisory Group Recommendations

- Migrate away from UAM for ozone
- Use state of science advection/dispersion platforms
- State of science meteorological modeling
- Migrate to SAPRC99 chemistry
- Compare model performance using relative reduction techniques

Selecting Modeling Platforms & Chemical Mechanisms

Pollutant	Dispersion	Chemistry	Meteorology
Ozone	CAMx	SAPRC99	MM5 or hybrid
PM10/2.5	CAMx	AERO-LT & CB-IV	MM5 or hybrid
Toxic	UAM	TOX	MM5 or hybrid

Basic Considerations in Selecting the modeling Platforms

- CAMx - Ozone
experience and performance similar to CMAQ
- CAMx - PM
Flexibility to install AQMD version of AERO-LT and compare to Environ aerosol chemistry
- UAMTOX – Toxic
Analysis consistency between MATESII and MATES III

3-Distinct Modeling Applications

Ozone

- Historical episodes from SCOS97 as primary simulation periods
- Augment analyses with either 2004 meteorological episodes from MATES III or, seasonal periods over several years
- Statistical analyses and RRF for carrying capacity

PM10 & PM2.5

- Annual Simulation: April 2004 –March 2005
- PM speciation a subset of MATES III

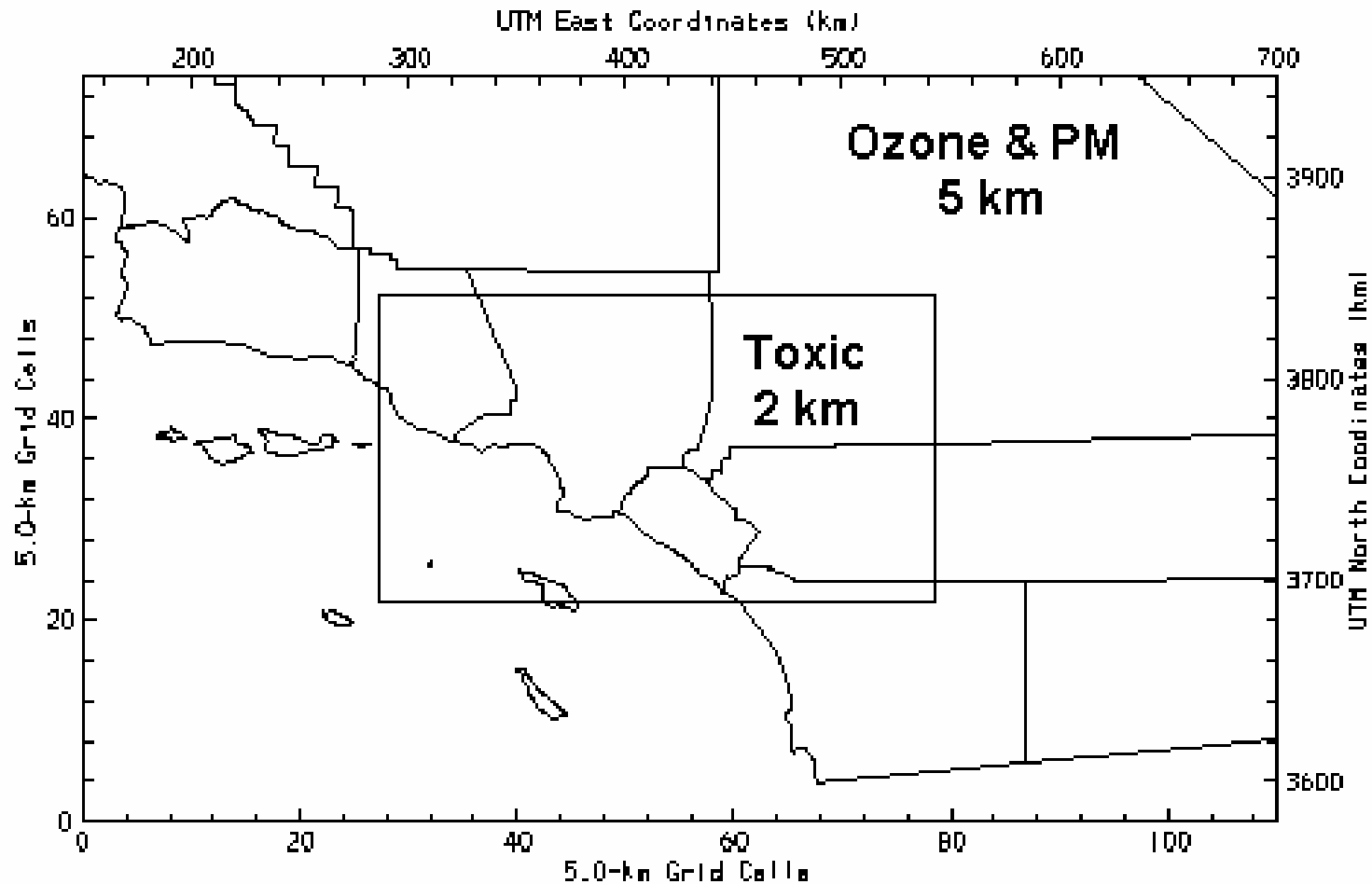
Toxic

- Multiple simulations for non-reactive, particles and reactive compounds

Basic Modeling Issues

- Domain size & origin (Local vs. Statewide)
 - Ozone & PM – SCOS97 Domain
 - Toxic – expanded MATESII
- Coordinate systems
 - Met – Lambert Conformal
 - Ozone – Lambert Conformal
 - PM – UTM
 - Toxic – UTM
 - Emissions – Lambert Conformal and UTM

Different Modeling Domains



Basic Modeling Issues (Continued)

- Emissions: base and future year
 - Ozone – speciated for SAPRC99
 - PM – Gas phase speciation for CB-IV
 - Particulate fractions for AERO-LT
 - Ammonia inventories by county
 - Toxic – AB2588 Hot Spot point source
 - Extended speciation for metals and gas phase compounds for TOX
- Boundary conditions for annual PM analyses

Meteorological Data and Modeling

- Episodic

SCOS97 high resolution sampling and analysis (MM5, hybrid, objective)

- Annual

- Daily archiving objective data
- Contractor provided MM5 prognostic fields
- Internally generated MM5 and hybrid

Computational Requirements

Computers/Processors

2- DEC Alpha's

1- 64 bit Itanium-2 dual processor

12 – Xeon processor cluster

Access to 16 CARB Xeon processors

Storage

100 gigabytes for meteorology

Annual PM ~ 15 gigabytes per
simulation

Annual Toxic ~ 40 gigabytes per
simulation

Simulation Turn-Around Times

- Toxic – Two to three weeks
- PM – 3 to 4 days dependent upon layer structure and domain size
- Ozone – hours to day

SIP Modeling Schedule

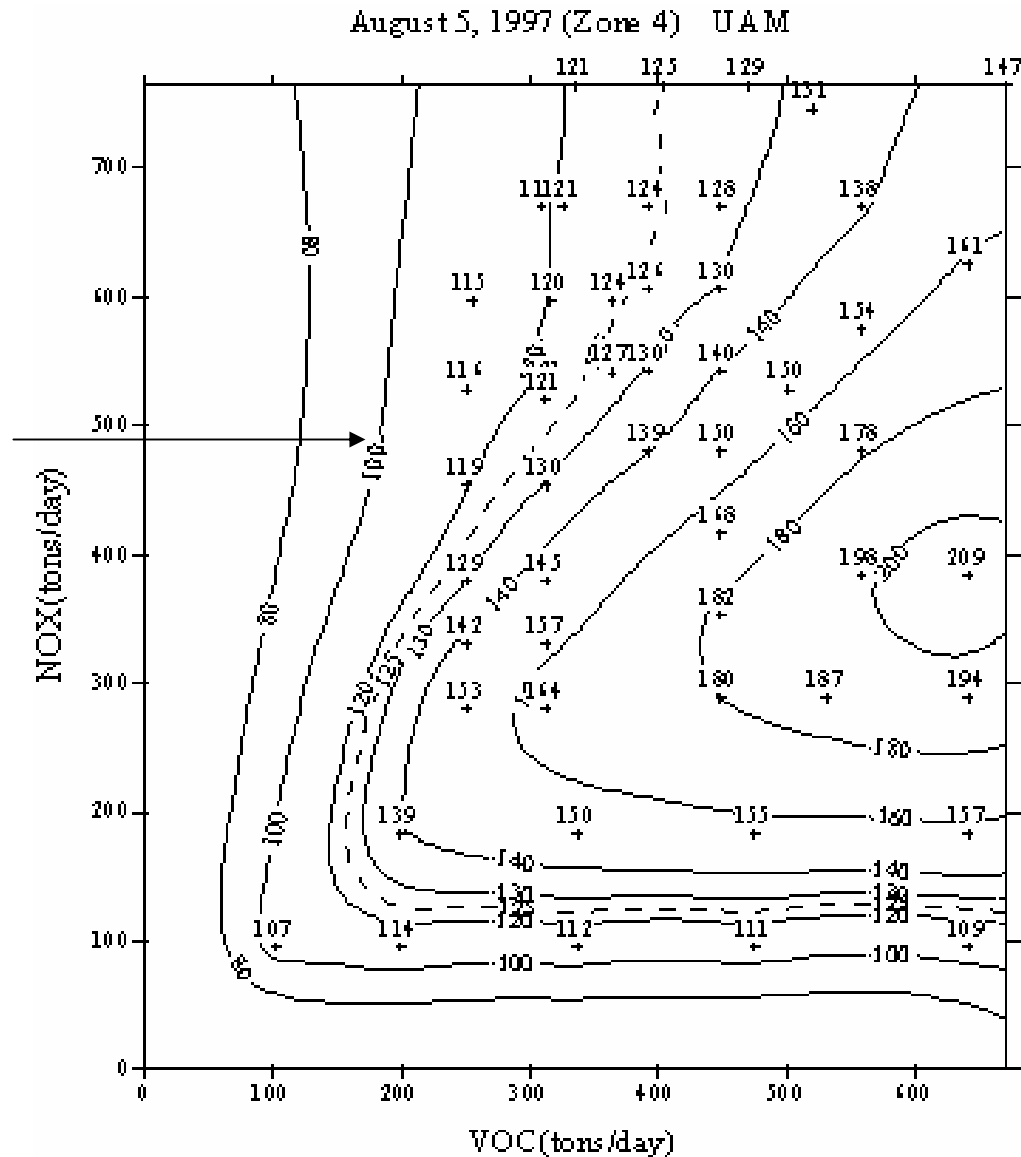
Tentative Date	Milestone
July 2005	Updated mobile & point emissions
July – Dec 2005	Base year episode development
Jan 2006	Fix Inventory & model validation
Feb 2006	Future year inventory
Spring 2006	Future year simulations and carrying capacity

2003 Control Strategy Development

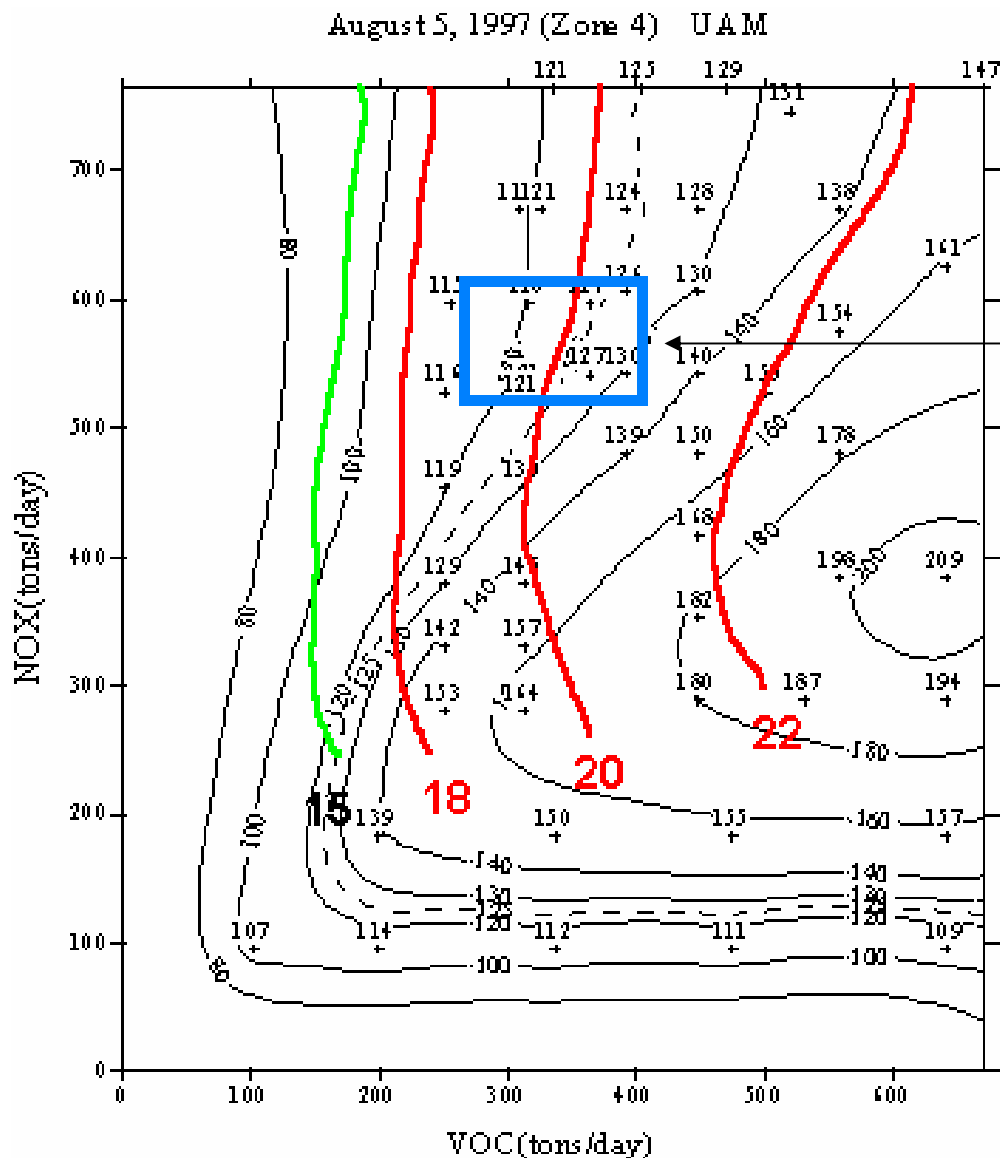
- Ozone & PM strategies must align
- Strategy addresses PM10 attainment first, then, 1-hour ozone
- Air Quality estimates for milestone years were made for neighboring and downwind air basins (e.g. 2005, 2007)
- 2010 attainment demonstration for 1-hour ozone with discussion of additional emissions reductions needed for 8-hour ozone and PM2.5

2003 AQMP Maximum Ozone Isopleth

100 ppb
1-hour
average is
roughly
equivalent
to 80 ppb
8-hour O3
design



Ozone Isopleth With Annual PM2.5



2010
Ozone
Control
Strategy

Particulate Strategy

PM10

- Identify directly emitted “fugitive dust” contribution and all possible controls
- Crustal approximately 45% of mass

PM2.5/PM10

- Secondary aerosol formation very sensitive to VOC emissions reductions
- Abundance of ammonium – less focus
- Nitrate and OC reductions in mass consistent with joint reductions of NO_x and VOC

Ozone Strategy

- Weekday strategy with weekend consideration
- 2010 and beyond the weekday and weekend simulated ozone converges
- “Black Box” availability?
- Reduce VOC and NO_x jointly to lower ozone (secondary nitrate and OC benefit)
- Ozone attainment (1-hour standard Federal and California) less sensitive to NO_x control
- Focus on earlier NO_x control to offset potential post 2010 major step reduction in emissions

2003 AQMP Peek Beyond 2010

- PM2.5 (2010)
 - Annual Average: 28 $\mu\text{g}/\text{m}^3$ (86% above standard)
 - 24-Hour: 66 $\mu\text{g}/\text{m}^3$ (2% above standard)
- 8-hour Ozone (2010)
 - 10.9 pphm (36% above standard)

MATES III Products

- Updated basin-wide and hot spot risk
- Deposition mapping
- Provide characterization of diesel particulate impacts
- Revisions to Toxic Control Plan
- Potential VOC rule development
- Potential NO_x and diesel PM rule development for ports and OGVs

Bringing The Process Together

- Coordinating meteorological data archiving and MM5 simulations
- Preliminary CAMx AERO-LT runs indicate no compromise in ozone generation when using aerosol module and CB-IV
- Testing CAMx (SAPRC99 and CB-IV) on June 2004 MATES II meteorology
- Toxic modeling commencing