BAAQMD Modeling Advisory Committee Meeting on Particulate Matter

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October 14, 2010

Meeting Agenda

- Overall SFBA PM2.5 study program plan
- Emissions inventory development for PM2.5 modeling
- Draft ultrafine particulate matter study plan
- Discussion

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Overall SFBA PM2.5 Study Program Plan

- Data analysis
- Emissions inventory development
- Modeling
 - MM5 and WRF
 - CMAQ
- Health impacts study
- Provide technical information to SIP development effort
- Preparation of documents, reports and papers
 - Preliminary modeling report available

MAC Meetings

June 3, 2010

- Attainment status
- Overall PM study plan
- Conceptual formation of SFBA PM
 - Data analysis
 - Emissions inventory
 - Modeling

October 14, 2010

- Emissions inventory in SFBA
- Draft ultrafine particulate matter study plan

January 2011

- Model performance evaluation following EPA guidelines
- Model sensitivity to changes in emissions
- PM transport

MAC Meetings (cont.)

April 2011

- PM health impacts study
- Summary of overall study findings
- Discussion

June 2011

- Prepare a draft document on study findings
- Receive feedback from MAC
- Finalize the document

Emissions Inventory Status

- Obtained preliminary modeling inventory from ARB for 2000 for CRPAQS domain
- Adjusted the inventory based on changes in ARB almanac for 2005 and 2015
- Replaced SFBA portion of the inventory with the BAAQMD CARE program inventory for 2005 and 2015
- Updated wood smoke estimate for SFBA
- Developed ammonia emissions inventory for SFBA
- Others

Emissions Inventory Status (Cont.)

- ARB plans to release a new inventory with 2005 base year in June 2011
- BAAQMD modeling will continue with the current inventory until then
- BAAQMD will review and evaluate ARB inventory, and compare it against the current inventory when ARB inventory is available
- Some base year and sensitivity simulations will be repeated with the new ARB inventory
- Model performance will be re-evaluated
- All modeling work be completed by the end of October 2011

Emissions Inventory Status (Cont.)

- We are using the U.S. EPA's SMOKE model
- QA/QC is a very important part of our work
- We have been participating in CRPAQS effort
- We have been participating in the Emissions Inventory Coordination Group meetings and conference calls

Emissions Inventory Development - Presentation Overview

- Framework
- Specifics of SFBA modeling inventory development
 - Core data and assumptions
 - Revision to winter wood burning emissions methodology
 - Development of SFBA NH3 emissions inventory
- SMOKE processing (emission inputs preparation)
- QA/QC

General Framework

- Previously
 - Received model-ready inventories from ARB
 - Used EMS95 for model input preparation
 - Modeling inventories for ozone, PM and toxics prepared independently
- Current approach
 - Single, unified database for O3, PM, toxics, UFP
 - Single emissions model to handle all processing needs
 - Local data wherever possible, clearly documented data elsewhere
 - Systematic QA/QC

2005 PM Modeling Emissions Inventory

- Based upon District's Base Year 2005 Planning Inventory
 - EMFAC2007
 - OFFROAD2007
 - Wood burning activity based on '05-'06 winter survey and updated emission factor

2005 PM Modeling Emissions Inventory (cont.)

- Leveraged work done for District's CARE Program to avoid inconsistencies and duplication of efforts
 - Adapted all applicable controls/adjustments assumed in CARE inventory development process
 - Adjusted OFFROAD diesel equipment emissions
 - » Based on fuel-based analysis, emissions were halved
 - » Recent UC Berkeley work showed overestimation by a factor of 3-4.5
 - » ARB announced significant changes in equipment population, construction equipment activity (-7 to -79%), load factor (-33%)

2005 PM Modeling Emissions Inventory (cont.)

- Used detailed spatial allocation surrogates
 - MTC link-level data processed through DTIM
 - » Corrected for local details such as HD restriction on I-580
 - Specific surrogates for residential fuel combustion
 - » Based on Census primary heating fuel data
 - Adjusted spatial distribution of shipping emissions

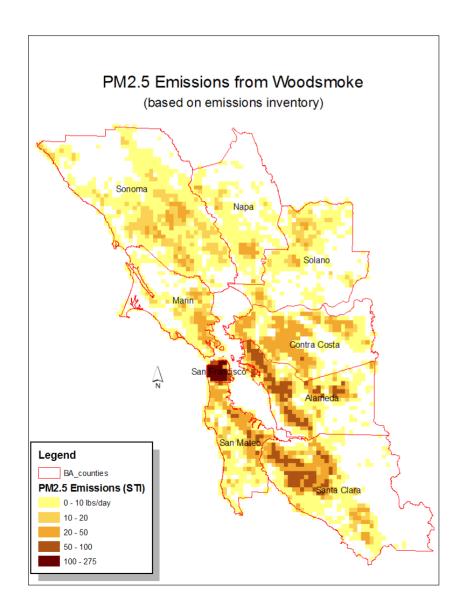
Winter Wood Burning Updates

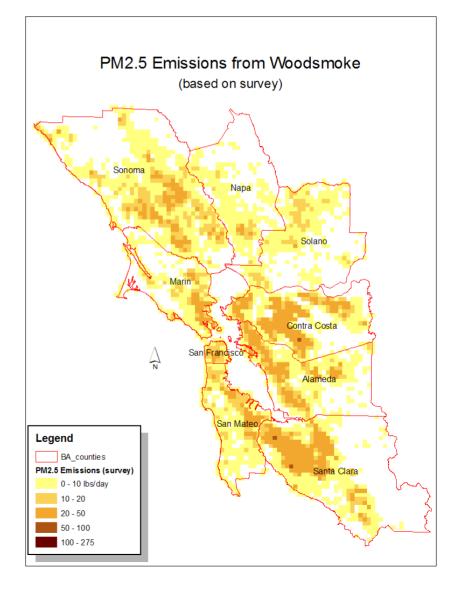
- Prior to 2005 base year inventory, wood burning emissions unreasonably high in urban areas, esp. S.F.
- To gain better insights, District began conducting surveys in 2003
 - Mostly the day after Spare the Air Tonight alerts
 - Originally, designed to measure public awareness, opinions, behavior relevant to wood burning
 - In 2005, expanded to include
 - Quantities of wood burned
 - Types of appliances
 - Frequency of burning
 - ~2600 participants

Winter Wood Burning Updates (cont.)

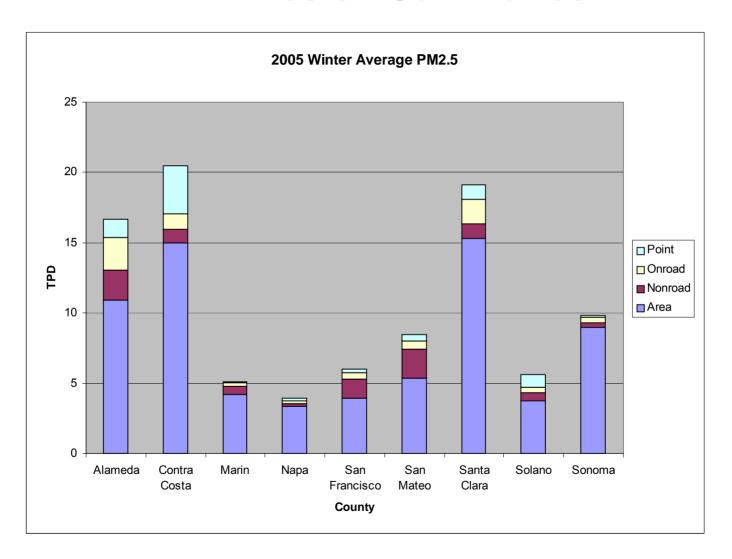
- Supplemented by neighborhood assessment
 - 2 neighborhoods in Napa Co., 2 in Contra Costa
 - Both show decreasing trend in wood burning
 - Earlier study showed 7% household burn
 - Recent study showed 4.8% household burn
 - Corroboration lends confidence to survey results
- Use of survey results replaced previous methodology
 - Resulted in 15% reduction for PM2.5 and 20% for NOx regionwide compared to previous estimates
 - S.F. emissions significantly reduced while Sonoma Co. increased

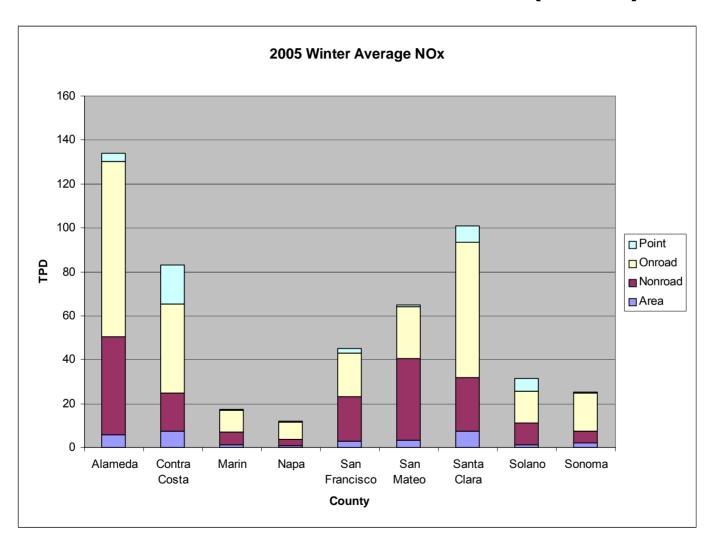
Winter Wood Burning Updates

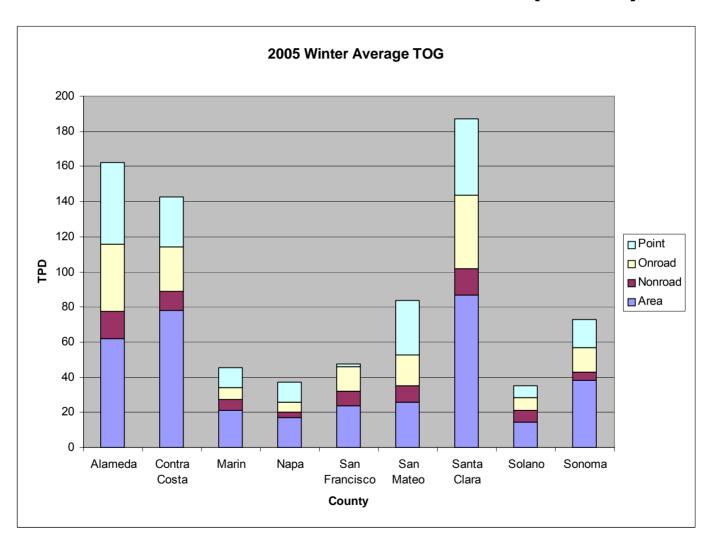


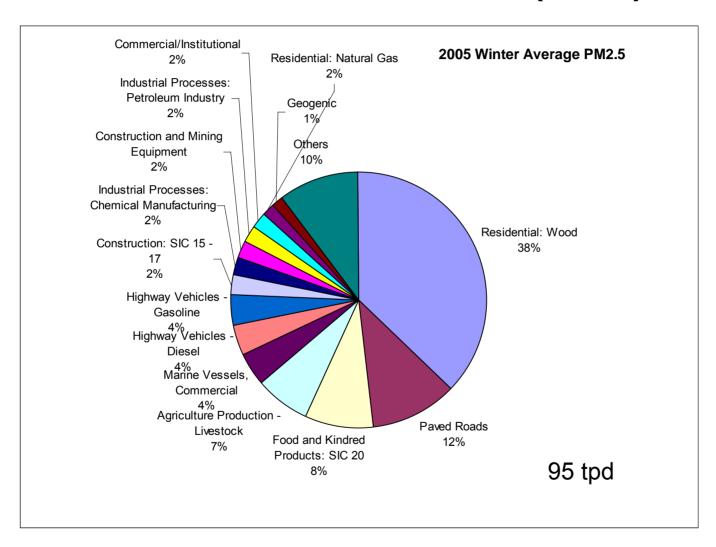


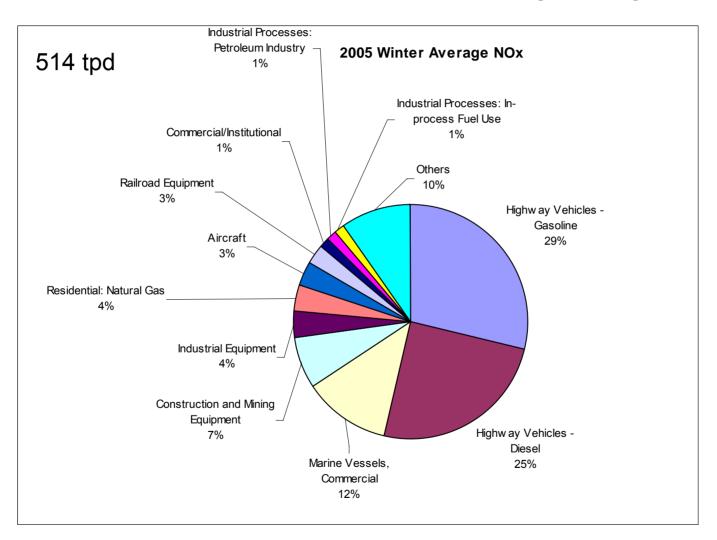
Emission Summaries

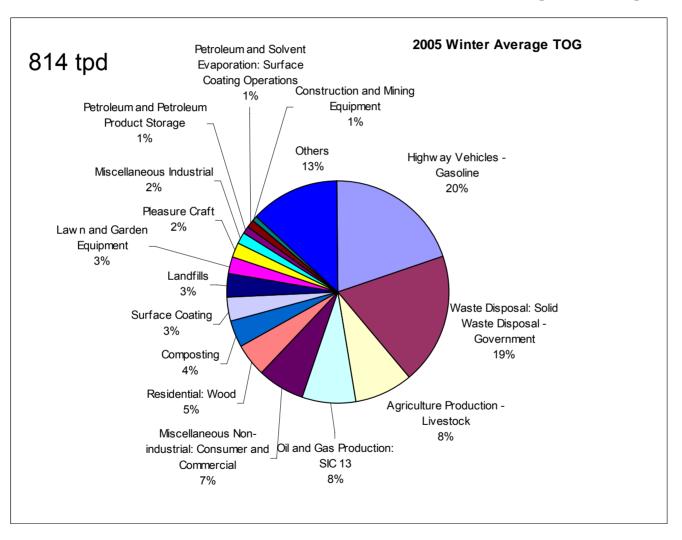












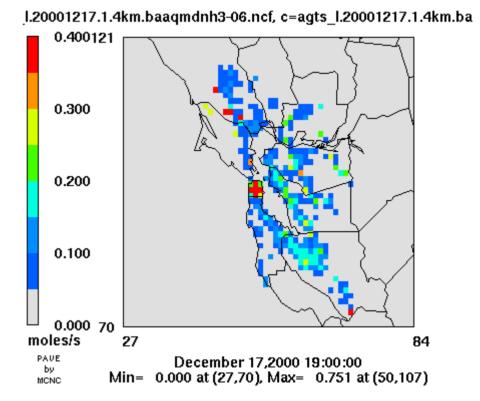
SFBA NH3 Emissions Inventory

- Received CRPAQS inventory from ARB
 - Emissions low compared to NEI (33.6 tpd vs. 52 tpd)
 - Practically no diurnal variation
 - Insufficient details for further QA
- Developed SFBA 2000 NH3 emissions inventory from scratch
 - Compared to CRPAQS inventory from ARB
 - 72 tpd (new) vs 33.6 tpd (CRPAQS)
 - More realistic diurnal variation
 - Relatively less emission density in Sonoma (less agricultural production)
 - More emissions around urban core



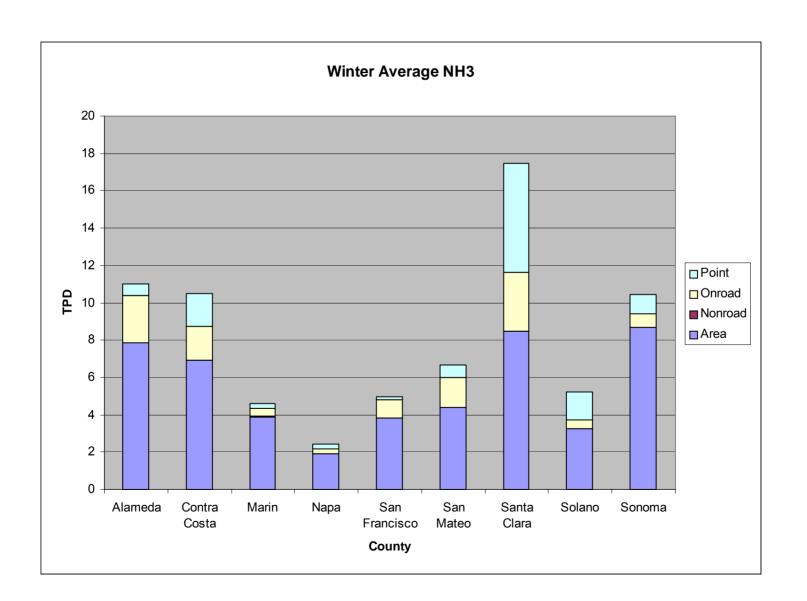
f=E352d08h24.nc 0.400121 0.300 0.200 0.100 0.000 68 MOLE/S 26 86 PAUE December 17,2000 19:00:00 Min= 0.000 at (26,68), Max= 0.993 at (85,85)

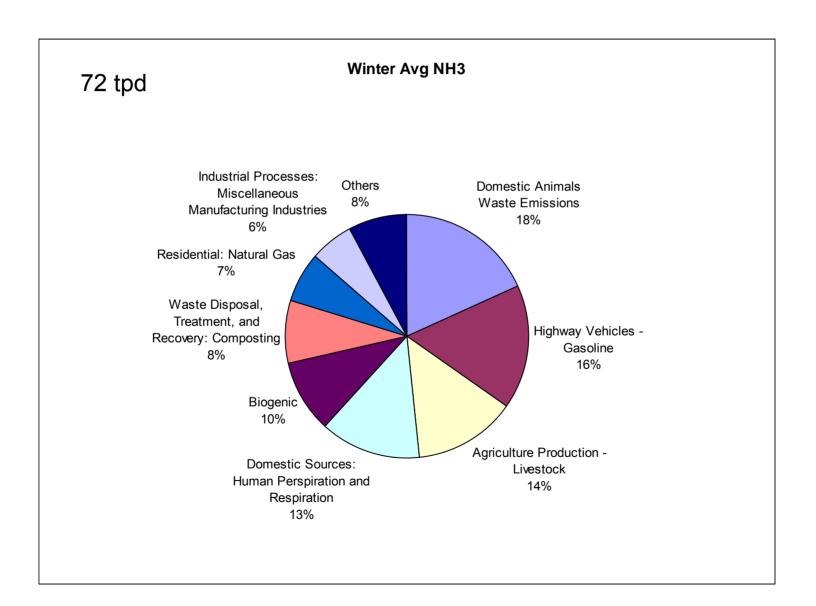
Layer 1 NH3a+NH3b+NH3c+NH3d



- Compared to 2000 NEI
 - New source categories misc. domestic, refrigeration, RWC
 - Large emissions differences in
 - » livestock (63% less in new inventory)
 - » stationary point source (74% more)
 - » onroad (31% less)
 - Net effects
 - » 20 tpd higher in new inventory
 - » emissions shift to urban areas where NOx is available

- Projected to 2005
 - Point ratio of District 2000 and 2005 permitted source data
 - Onroad EMFAC2007 VMT growth
 - Area and nonroad US EPA Economic Growth Analysis System (EGAS) 5.0





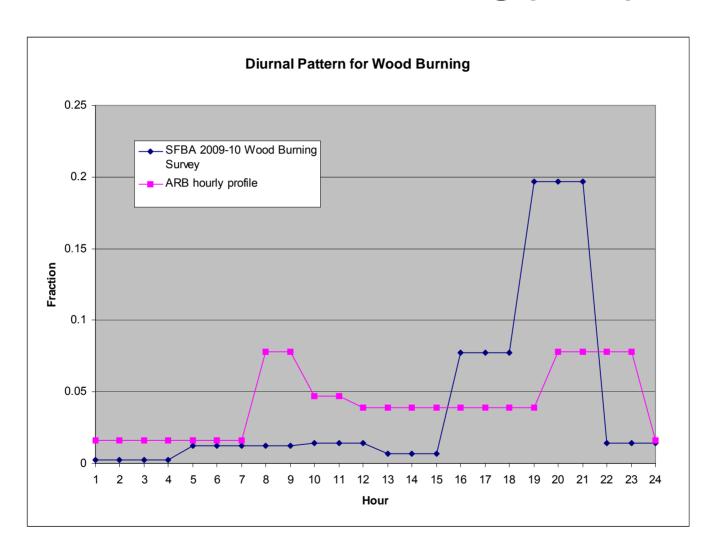
SMOKE Processing

- Purpose is to prepare AQM-ready inputs from county-level annual average emissions
- US EPA's Sparse Matrix Operator Kernel Emissions (SMOKE) model selected because
 - Well-documented and supported by CMAS
 - Can handle PM, O3, toxics, UFP
 - Flexibility in creating UAM-formatted inputs

SMOKE Processing (cont.)

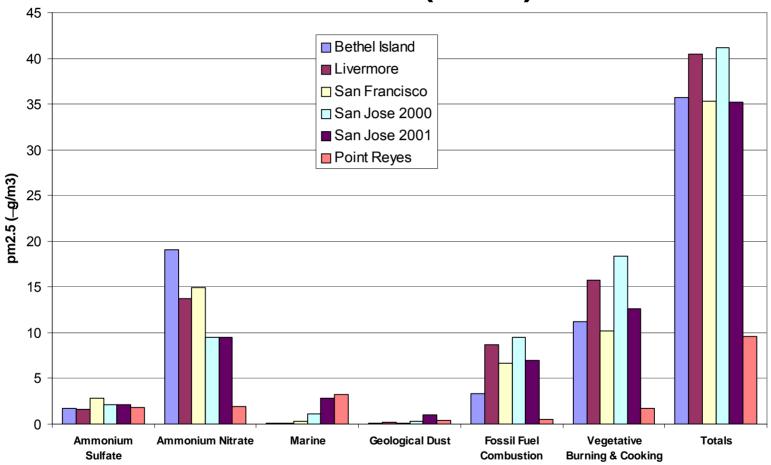
- 3 steps: spatial allocation, temporal allocation, chemical speciation
 - Temporal allocation
 - Locally-derived temporal profiles preferred
 - ARB temporal profiles where available
 - SMOKE default profiles (US EPA's)
 - Speciation
 - SAPRC99 chemical mechanism

SMOKE Processing (cont.)



QA/QC

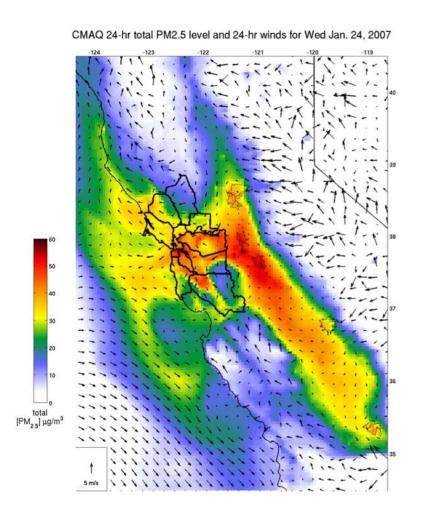
- Evaluation phase ("reality checks")
 - Compare to other available inventories
 - for same area earlier versions, trends across different years
 - for similar areas compare normalized emissions or other metric (e.g. wood burning per household)
 - Compare to ambient measurement ratios
 - CMB analysis
 - C-14 analysis (recent winters only)
 - NH3 measurements

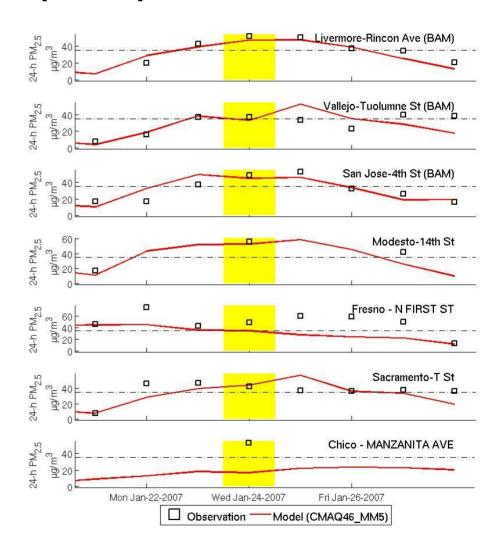


Note: Estimated source contributions to peak Bay Area ambient PM2.5 for 2000 and San Jose 2001. Values are averages of CMB and C-14 estimated source contributions from 10 days with highest PM at each site. Totals are sums of individual source contributions.

Area/Site	NH3 Emissions	Ambient [NH3]
San Jose	17.5 tpd	9.2 ppb 7.8 µg/m ³
Concord	10.5 tpd	4.5 ppb
Fremont	11.0 tpd	3.7 μg/m ³
Ratio Concord/SJ	0.60	0.49
Ratio Fremont/SJ	0.63	0.47

- Use AQM performance to help diagnose inventory and identify potential areas for improvement
 - Iterative process
 - Over-/underestimate? Magnitude?
 - Where, when?
 - Consistent? Systematic?
 - Primary or secondary?





- Processing phase ("independent audits")
 - Multiple staff involved
 - SMOKE reporting utilities customized to track total mass
 - PAVE/GIS to check spatial variation
 - Matlab to check model species-level temporal allocation
 - Every hour of the modeling period
 - Weekday/weekend differences
 - Key species (e.g. NH3, PEC, NO, etc)

Ultrafine Particulate Matter Study

- PM measurements as indicator of pollutant exposure
 - Mass concentration (PM_{2.5} and PM₁₀)
 - Number concentration (PM $_{0.1}$), also known as ultrafine PM (UFP)
 - Smaller particles may be more harmful to human health
 - May penetrate deeply into human tissues
 - Very large surface area
- Proposed BA pilot study
 - Data analysis
 - Emissions inventory development
 - Monitoring
 - Modeling
 - Health impacts assessment
 - Reporting results

Ultrafine Particulate Matter Study (Cont.)

- Data analysis
 - Identify weather patterns impacting regional UFP levels
 - Develop a conceptual model
- Emissions inventory development
 - Estimate UFP emission factors
 - Leverage existing PM_{2.5} activity data
 - Process at 1x1 km resolution using SMOKE
- Monitoring
 - Sample at 3 stations representing regional UFP levels
 - Provide ambient measurements for exposure assessment
 - Support data analysis and model evaluation
- Modeling
 - Explore 2 models: CMAQ-MADRID and CAMx
 - Simulate annual average UFP levels over entire BA at 1x1 km resolution

Ultrafine Particulate Matter Study (Cont.)

- Health impacts assessment
 - Assess UFP exposure around monitors using ambient measurements
 - Assess regional UFP exposure using simulation results
 - Quantify adverse health impacts
 - Monetize economic impacts
 - Quantify and monetize benefits of future emission reductions
- Reporting results
 - Report findings
 - Provide information to interested parties for future UFP studies

Ultrafine Particulate Matter Study (Cont.)

Collaborators

- BAAQMD, multiple Divisions and Sections
- UC Davis
- ENVIRON International Corporation
- Sonoma Technology, Inc.
- OEHHA/CalEPA
- Others

Schedule

- Complete pilot program in three years
- Make recommendations for future study needs

Thank you

Questions and Comments