



Photochemical Modeling for the Bay Area 2004 SIP Revision for the 1-Hour Ozone NAAQS

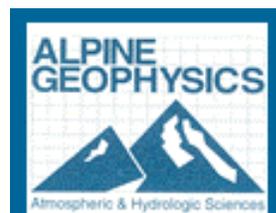
by
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**ENVIRON International
Corporation**

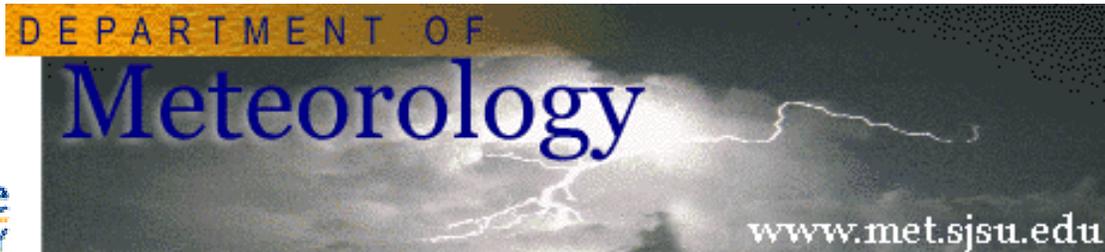




Contributing Consultants/Contractors



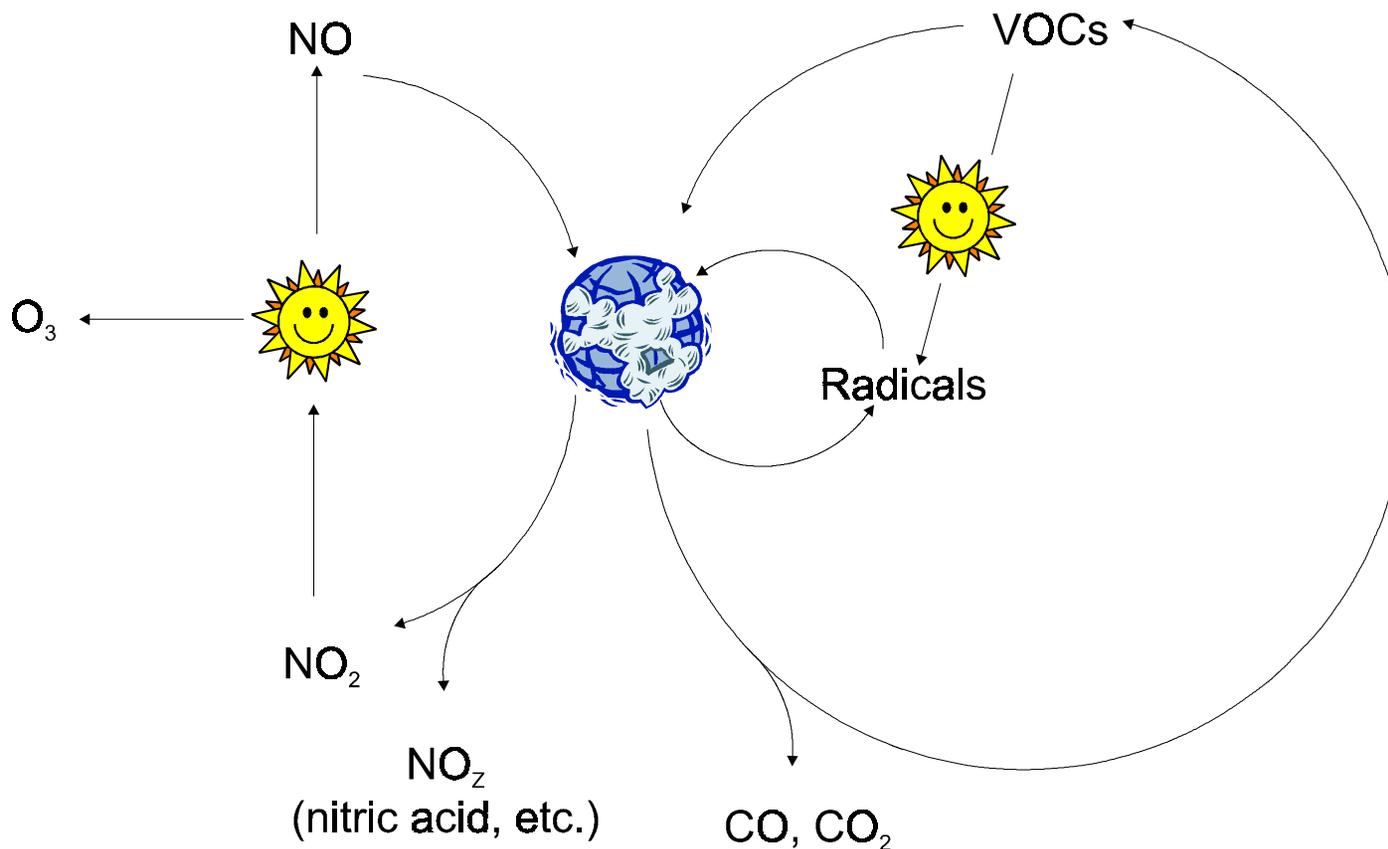
Alpine Geophysics, LLC
Offering Expertise in
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Ozone Modeling Basics

- **The ozone situation in the Bay Area**
 - “Exceedance levels” 1999-2002: 126-160 ppb
 - 1-hour ozone NAAQS: 124 ppb
- **Ground-level ozone (smog) results from emissions of “precursor” hydrocarbons (HC, TOG, VOC) and oxides of nitrogen (NO_x)**
 - These react in the presence of sunlight
 - Higher temperatures increase reaction rates



- no sunlight** ⇒ **no ozone production**
- no NO_x** ⇒ **no ozone production**
- no VOC** ⇒ **no ozone production**

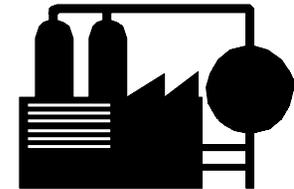
Ozone Modeling Basics (continued)

- **Emission sources include:**

- Biogenic (trees, foilage, and soil)



- Stationary (e.g., electric utilities, refineries)



- Area (e.g., residential, commercial, paints/solvents)





Ozone Modeling Basics (continued)

- On-road mobile (cars, trucks, motorcycles)



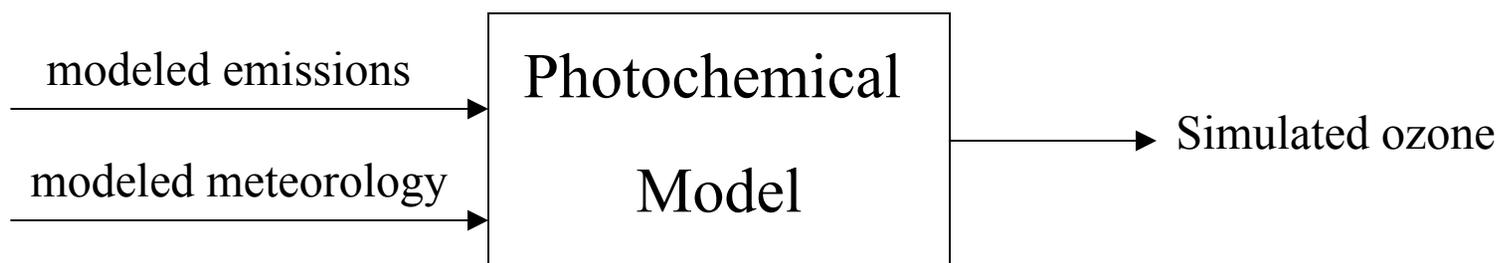
- Off-road mobile (construction, recreation, lawn/garden, rail/air/marine)



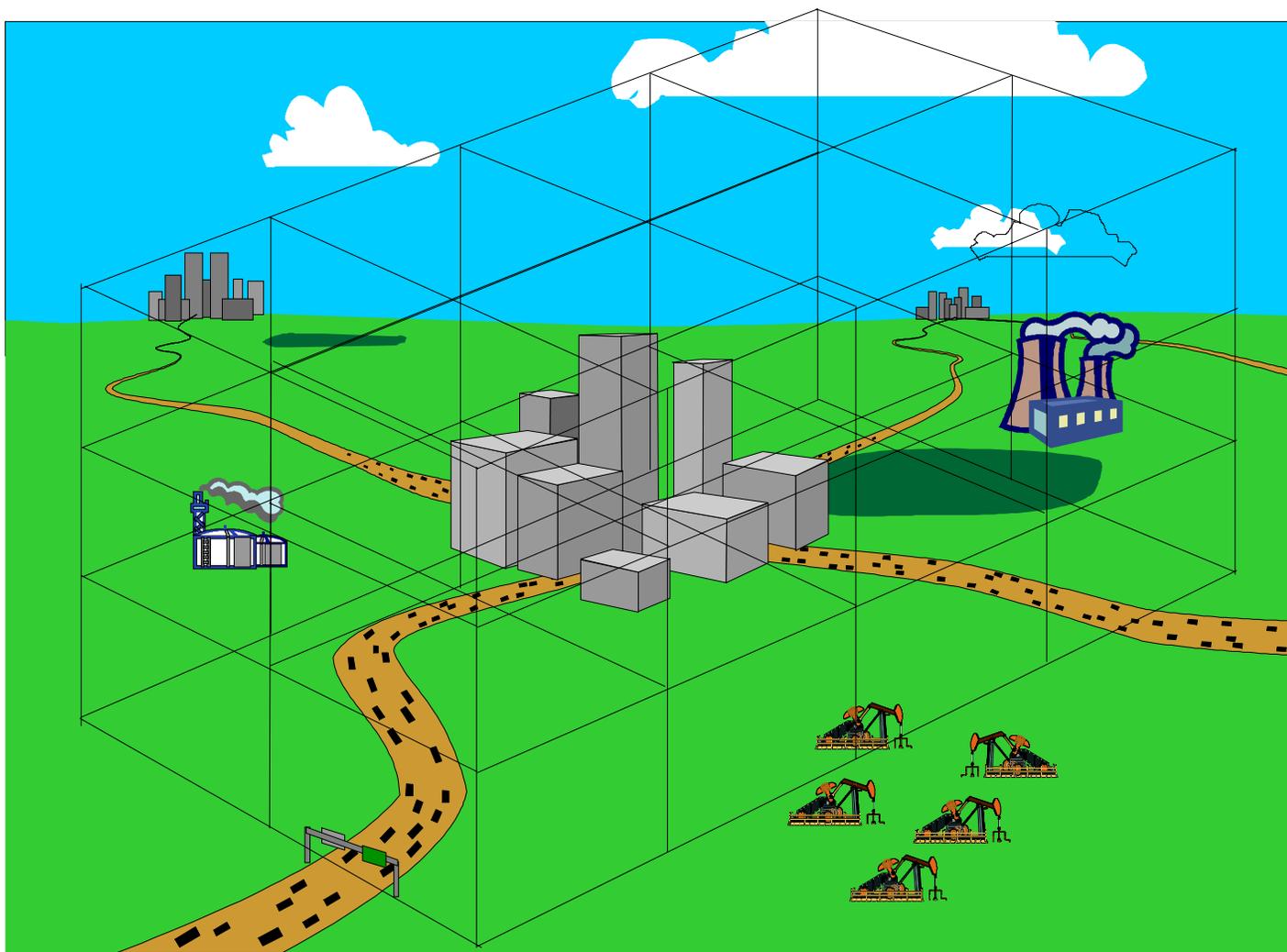


Ozone Modeling Basics (continued)

- **What is modeling and how is it done in SIP context?**
 - 3-D deterministic mathematical model
 - i.e., model is not defined by ambient observations
 - Characterization of input meteorology and emissions must be highly accurate
 - We rely on models to estimate these components as well



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Ozone Modeling Basics (continued)

- Model considerations and selection
 - State-of-science
 - Adequately supported; continual upgrades and new features
 - Public domain
 - “Consistent” with CARB CCOS effort



Ozone Modeling Basics (concluded)

- Modeling Process:
 - Replicate several historical high ozone episodes to establish acceptable model performance
 - Substitute projected emission estimates to establish “future” conditions
 - Test effects of various control strategies on future case
 - Determine emissions reduction target for future attainment
 - Model attainment strategy



What is CCOS, why is it important?

- **Central California Ozone Study components:**
 - Field monitoring program conducted during the summer of 2000
 - Data analysis (on-going)
 - Emission inventory development (on-going)
 - Photochemical modeling (on-going)
- **Public/private partnership**

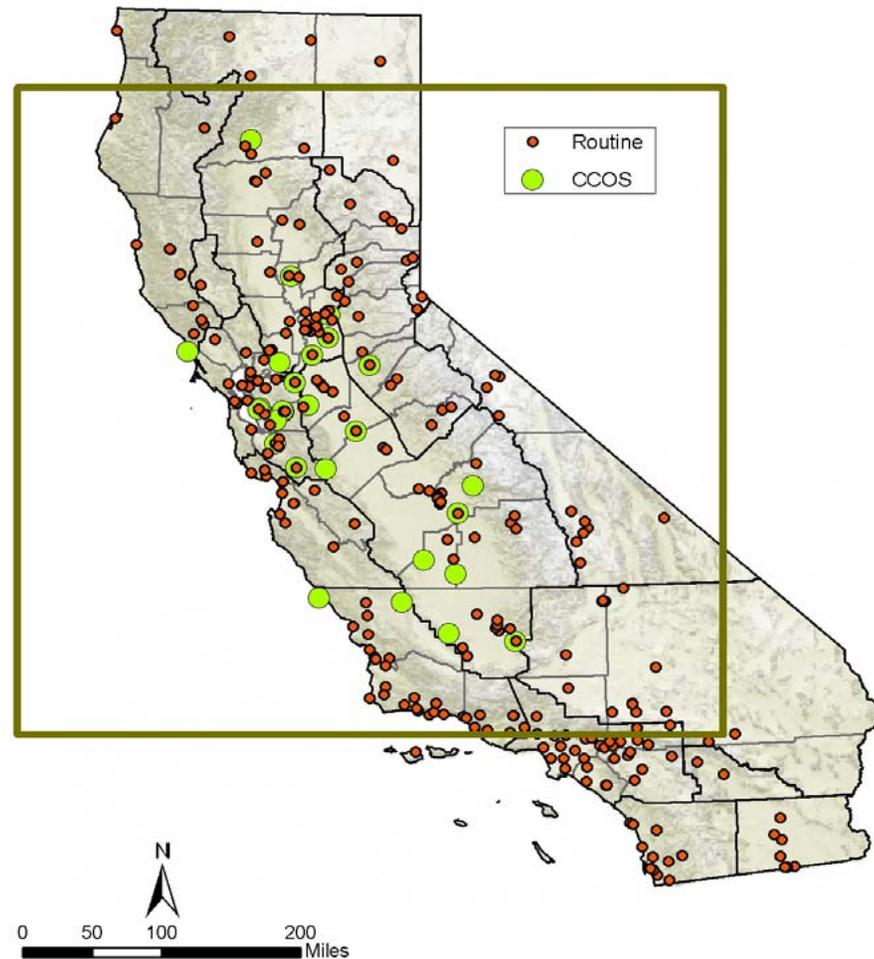


What is CCOS, why is it important? (continued)

- **Provides scientific foundation for ozone State Implementation Plans**
 - San Joaquin Valley (end 2003)
 - Bay Area (early 2004)
 - Sacramento Valley (mid 2004)



Air Quality and Meteorological Sites





What is CCOS, why is it important? (concluded)

- **Several documents describing the study are available at
(<http://www.arb.ca.gov/airways/ccos/ccos.htm>):**
 - The Central California Ozone Study - Final Report (Summary of Field Operation, Vol III.)
 - The Central California Ozone Study - Scope of Work (SIP Plan)
 - The Central California Ozone Study - Comprehensive Plan



Bay Area Modeling Effort

- **Modeling is state-of-science**
 - CAMx v4 (photochemical)
 - RAMS & MM5 (meteorological)
 - EMS-95 (emissions preprocessor)
 - EMFAC2002 (ARB on-road mobile source model)
 - BEIGIS (ARB biogenics model)
 - Congruent with CARB CCOS modeling



Bay Area Modeling Effort (continued)

- **2004 SIP is key objective, but other uses:**
 - 1-hr & 8-hr ozone, and PM_{2.5} planning
 - Regional land use planning
 - Inter-district transport assessments and responsibilities
 - Will provide District with extensive in-house modeling capabilities



Very Large Effort

- **Heavy involvement of many agencies**
 - EPA, CARB, other AQMDs, MTC, CalTrans
 - Others including public interest and industry
 - Funding:
 - \$500,000 from BAAQMD
 - \$200,000 from MTC
- **“Transparent” technical work**
- **Project is exceptionally well vetted**
 - Fourth draft of protocol document available on-line



Very Large Effort (concluded)

- **CARB has major role as data source**
 - Air quality and meteorological measurements
 - Emissions estimates (base year + future years)
- **Project is delayed: CARB is behind schedule to provide data**
 - ENVIRON and District are undertaking CARB's work
 - Nevertheless, we are moving ahead as quickly as possible



Some Details

- **Episode selection**
 - Represent likely/common event?
 - Represent sufficiently high ozone?
 - Represent local and/or regional ozone?
 - Quality of measurement data for episode?
- **Selected Episodes**
 - July 31 – August 2, 2000
 - June 14-15, 2000
 - July 11-12, 1999



Some Details (continued)

- **July 31 – August 2, 2000**
 - Only CCOS with exceedances in BA, SV, and SJV
 - But exceedances are lower than all areas' design values
 - Use valuable CCOS “intensive” measurements to verify/validate model performance
 - Characterized as BA Type II category (of two common types identified by District)
 - Type II = single isolated exceedance
 - Usually in East Bay (most commonly in Livermore)



Some Details (continued)

- **June 14-15, 2000**
 - Highest ozone in BA during CCOS (152 ppb)
 - Sharp isolated peak in Livermore
 - Not during CCOS IOP
 - Cannot take advantage of augmented measurement database
 - Characterized as BA Type II category

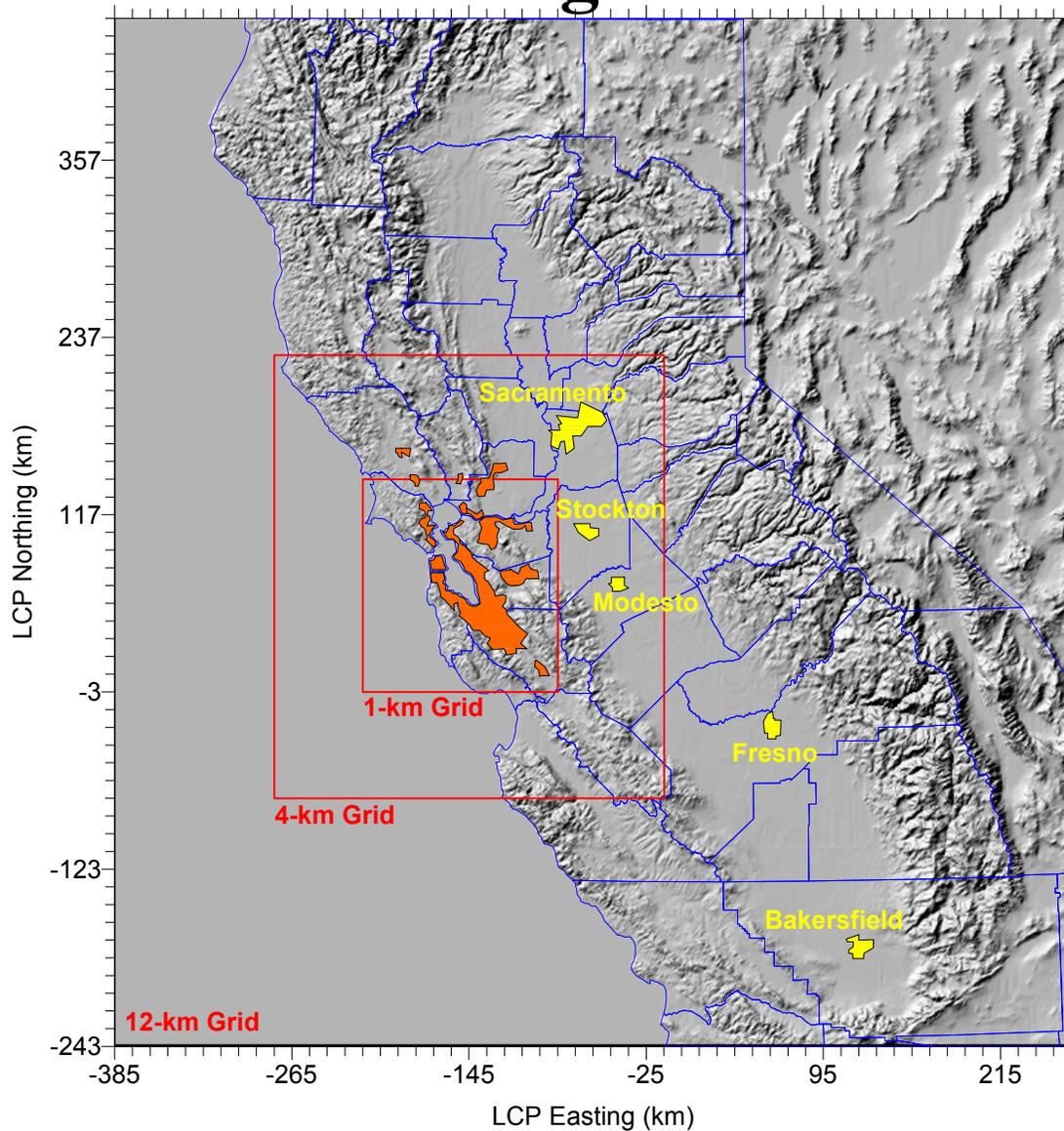


Some Details (continued)

- **July 11-12, 1999**
 - Best recent episode
 - Numerous BA exceedences on par with current design value
 - Widespread exceedences in SV and SJV
 - Characterized as BA Type I category
 - Type I = widespread ozone exceedences in East and South Bay
 - Selected to balance Type II CCOS episodes



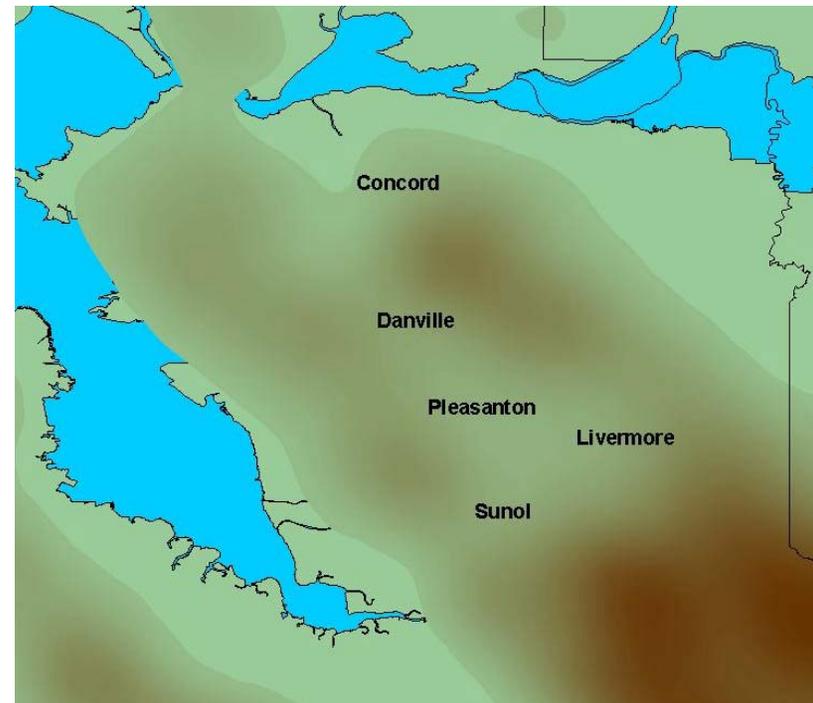
Modeling Domain



Terrain Representation in Models



Actual terrain pattern

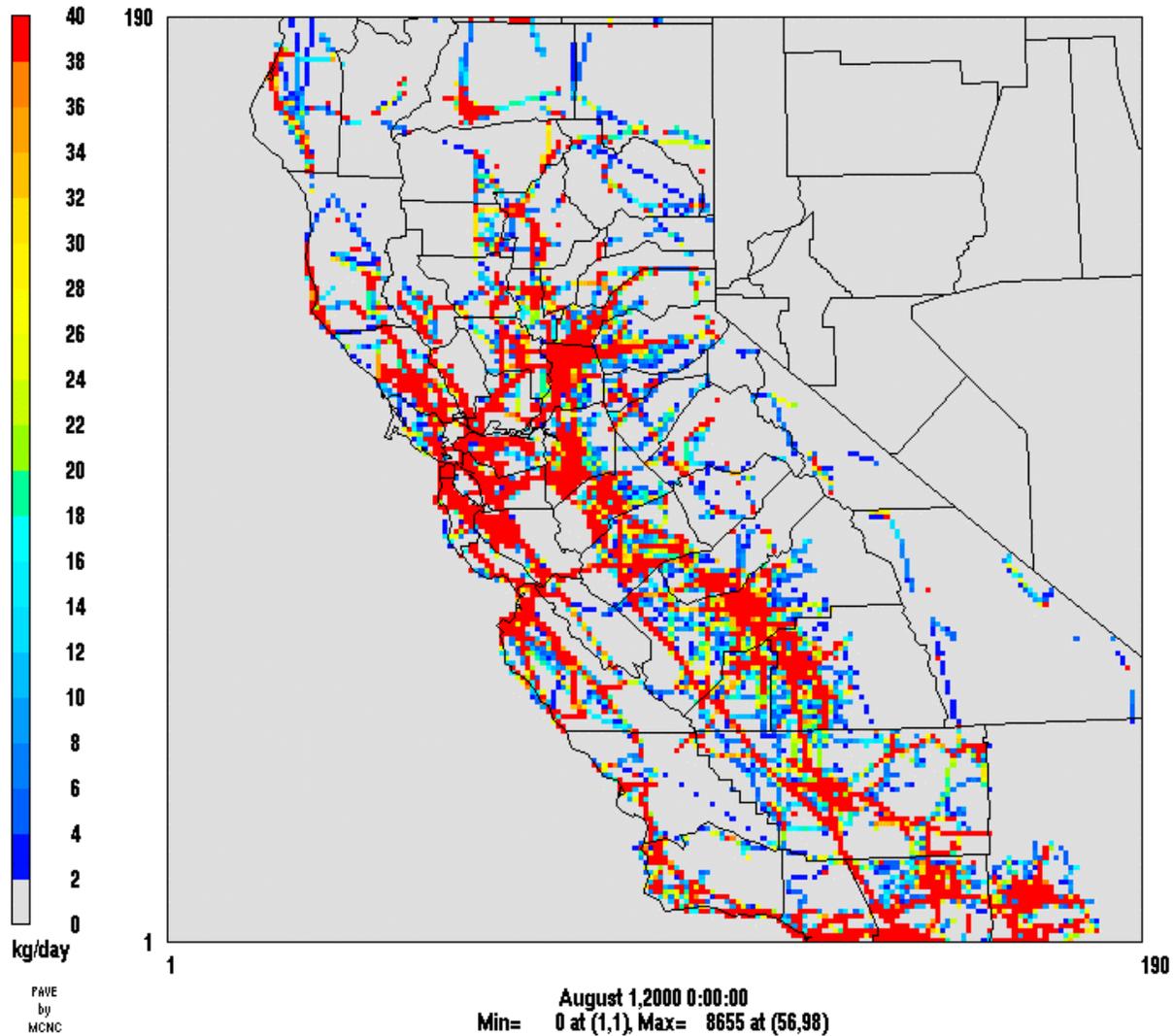


At 4 km resolution



Mobile Source NOX

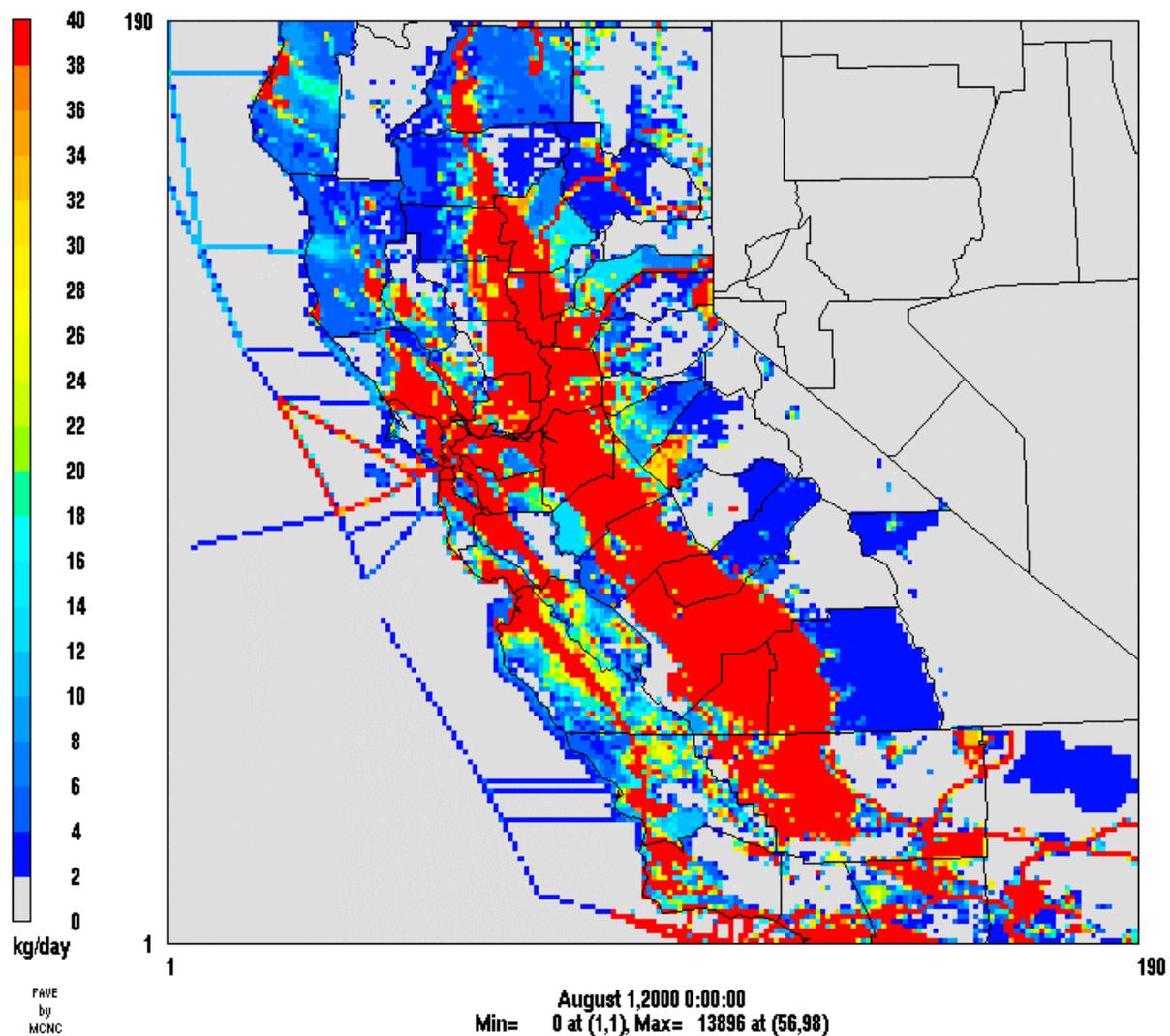
29 July 2000 through 02 August 2000





Area Source NOX

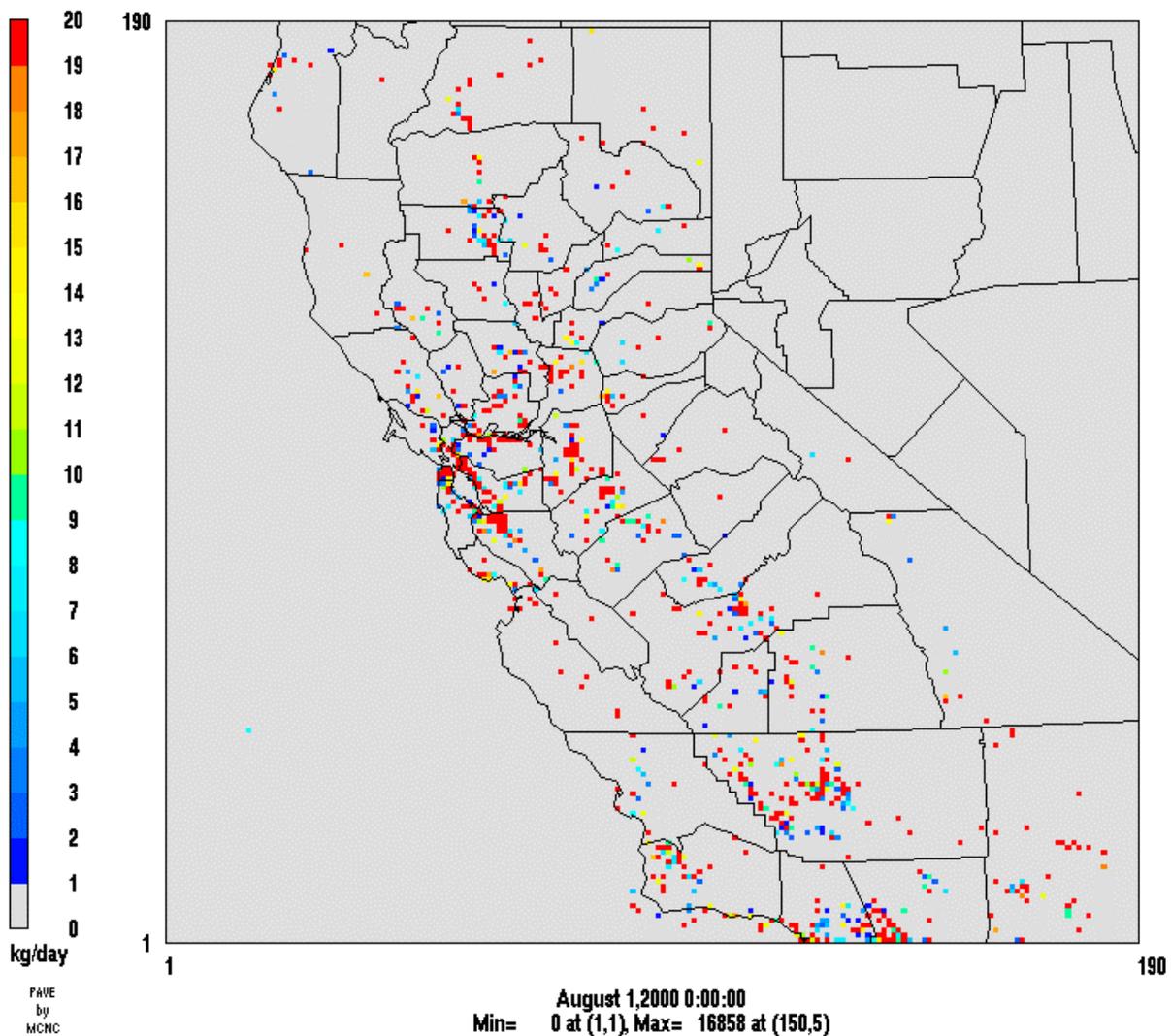
29 July 2000 through 02 August 2000





Point Source NOX

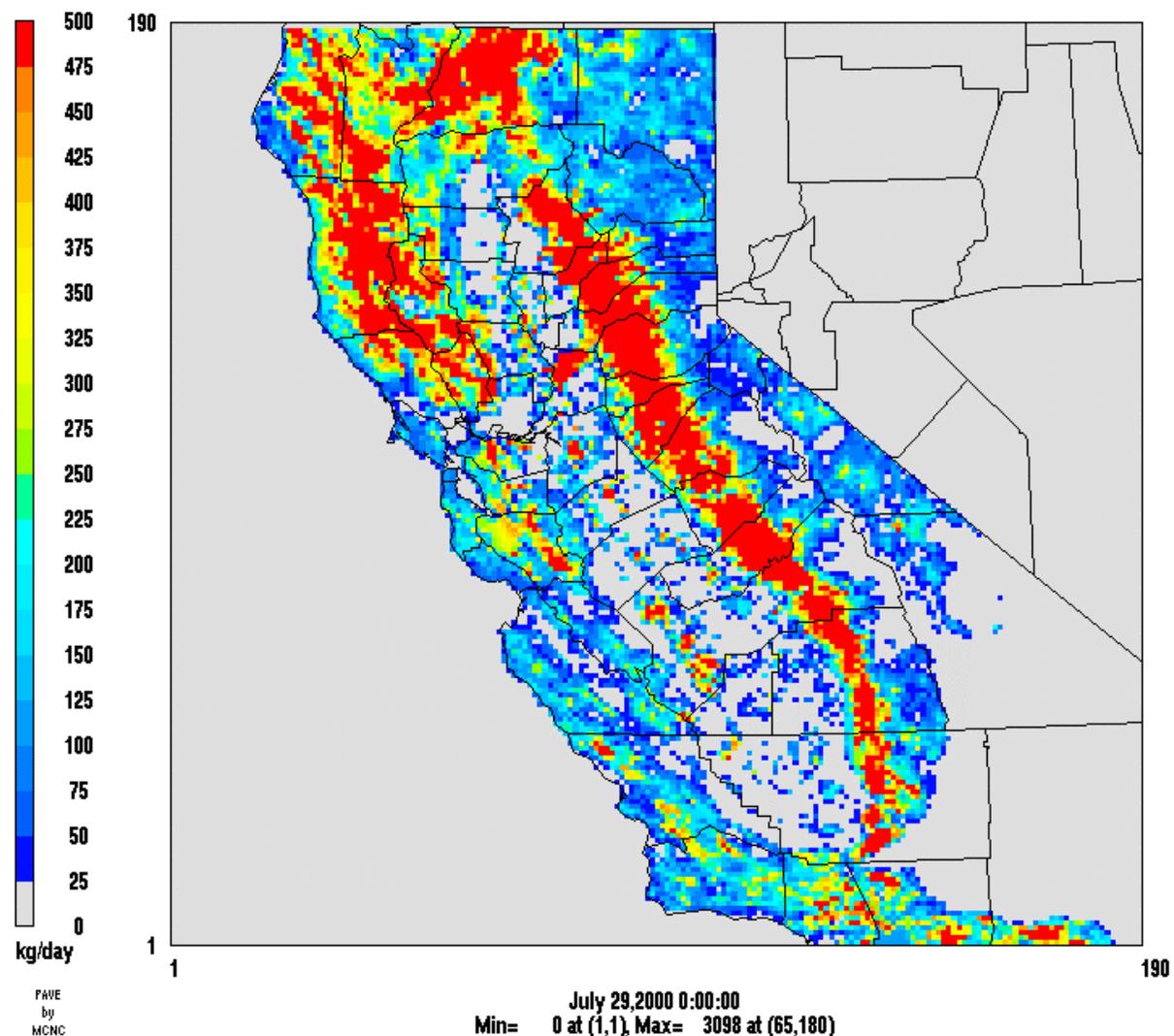
29 July 2000 through 02 August 2000





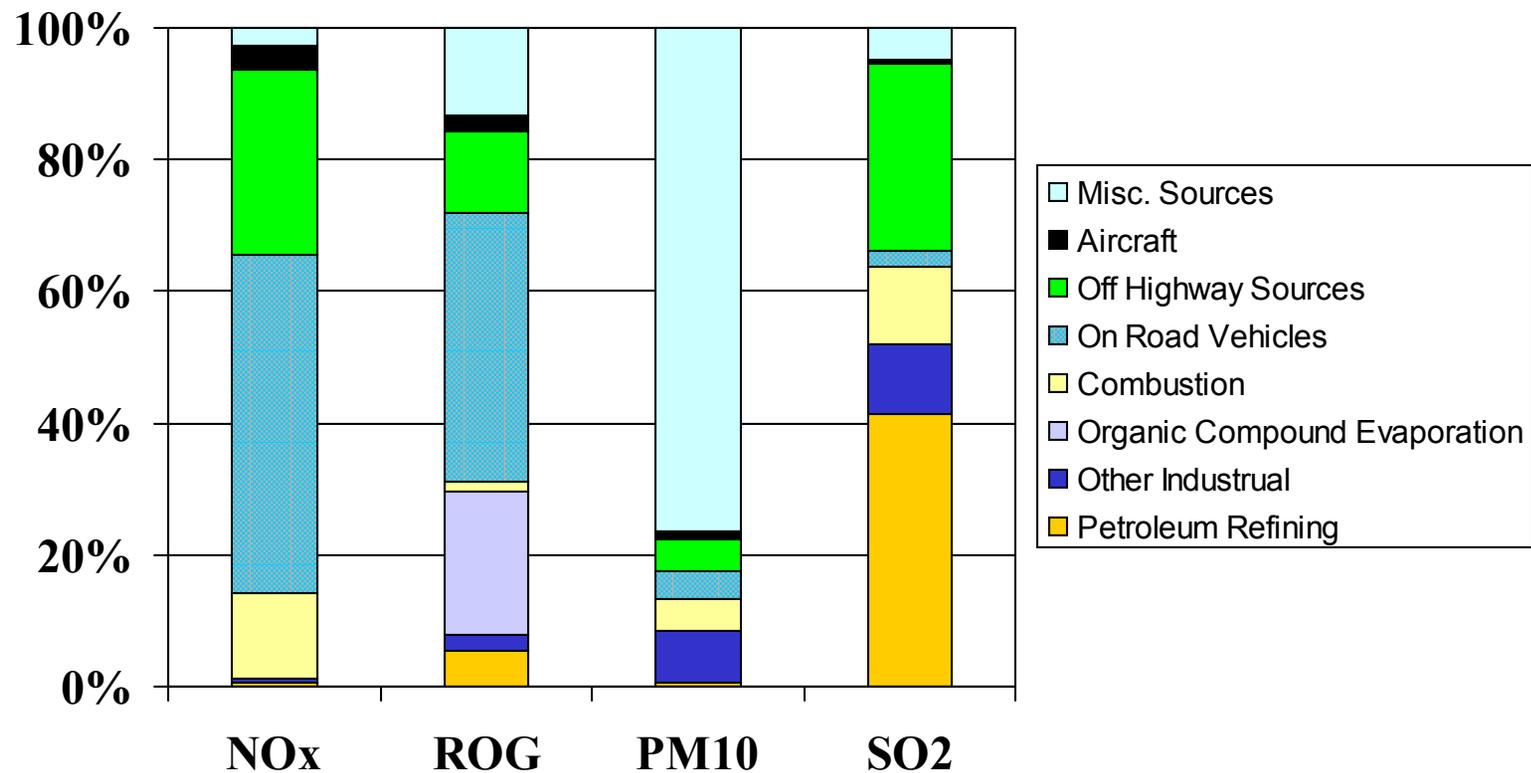
Total Biogenic Organic Gases

29 July 2000 through 02 August 2000





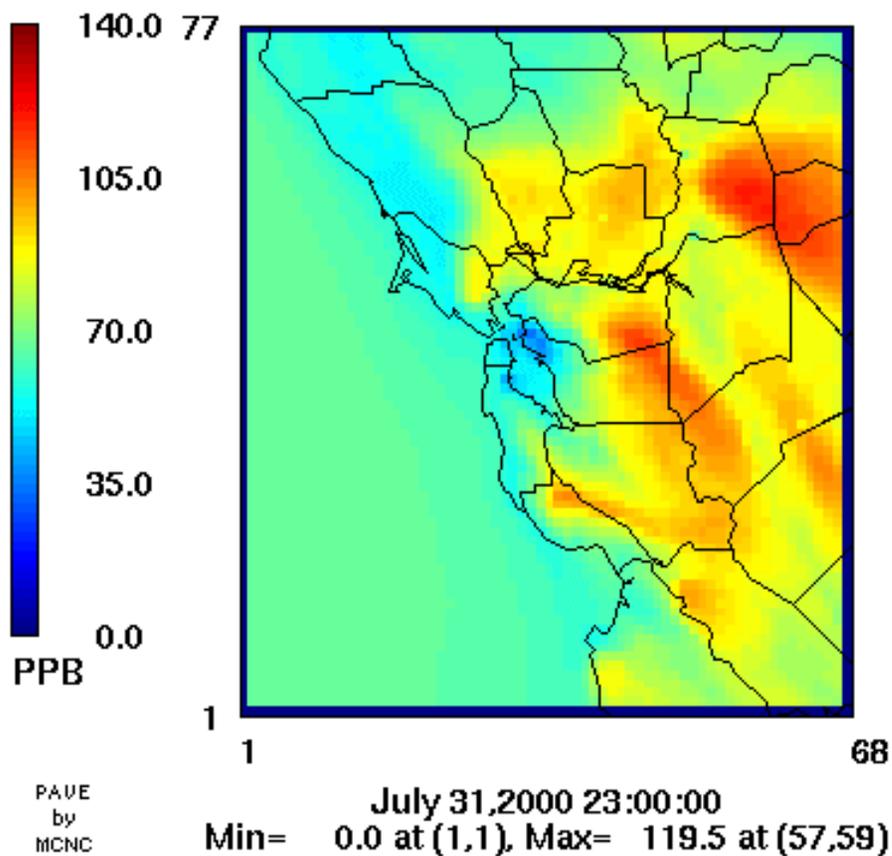
Percent Distribution of Projected Bay Area Anthropogenic Emissions: Summer 2003





Daily Maximum Ozone

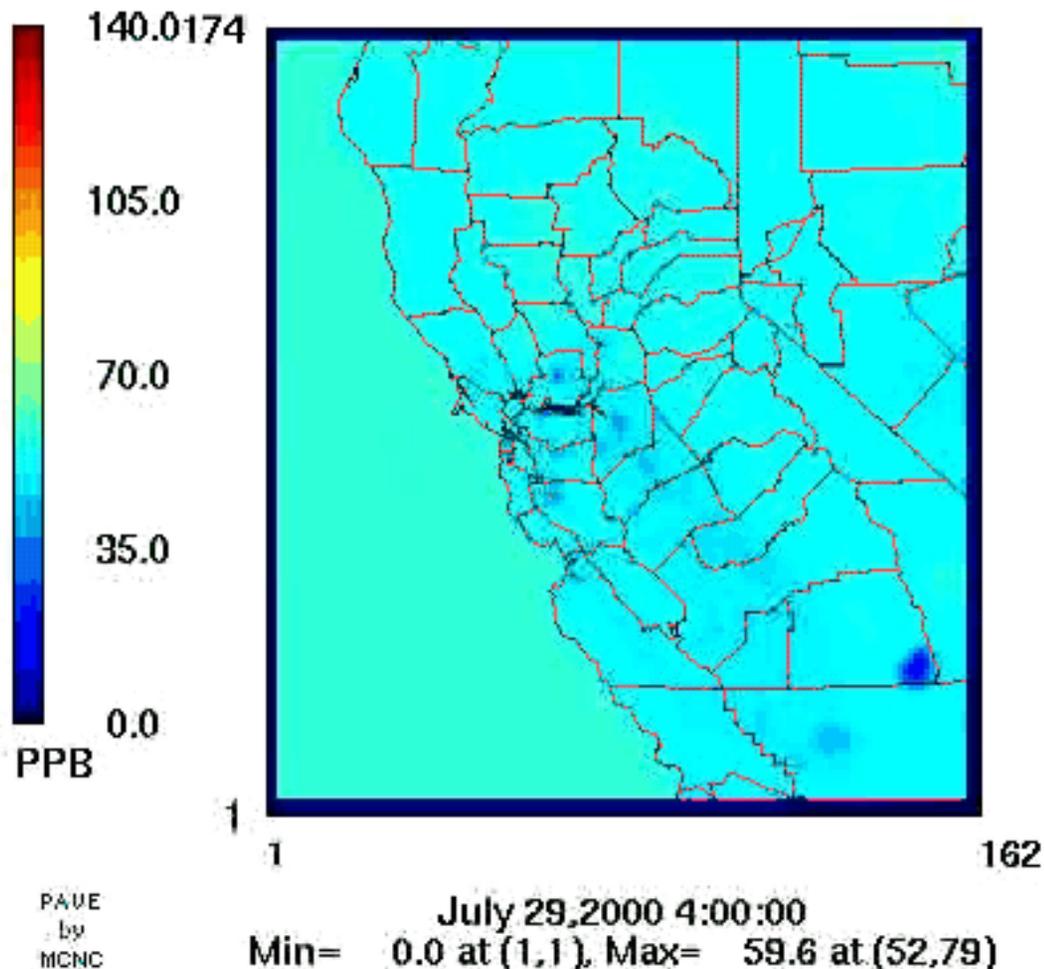
CAMx v3.10 Run 4m, 4km domain
July 29 - August 2, 2000





Layer 1 Ozone (Animation)

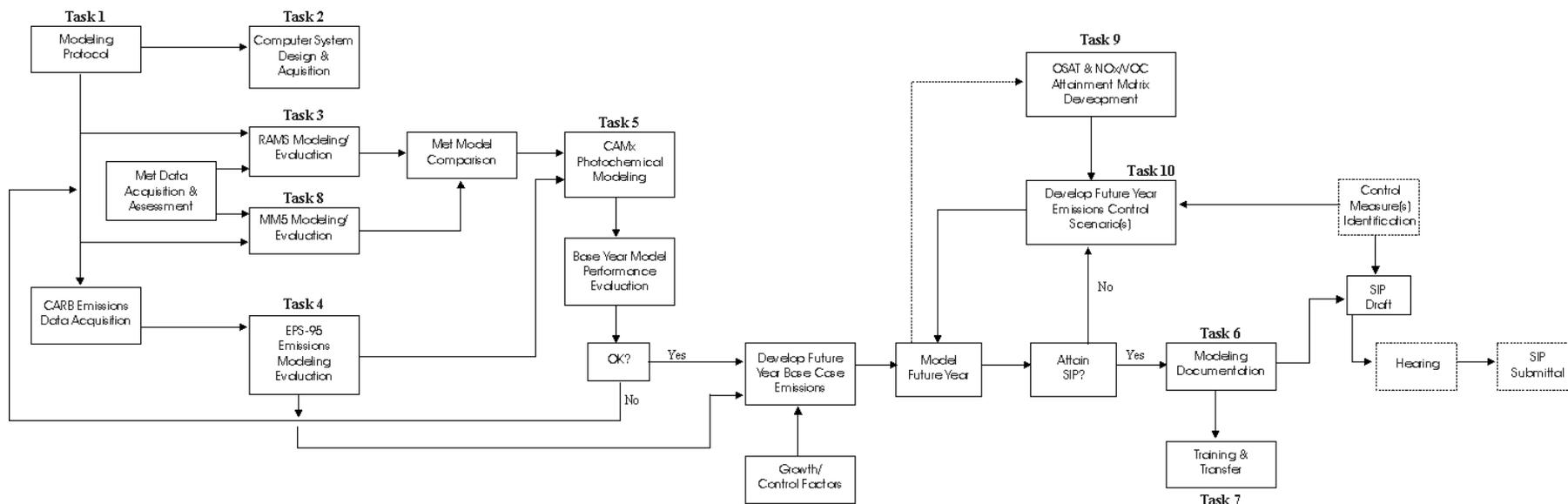
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Route to Ozone SIP Attainment Demonstration and SIP Approval

BAAQMD 2004 Ozone SIP Development





Questions and Answers