Southern California Model Performance Evaluation

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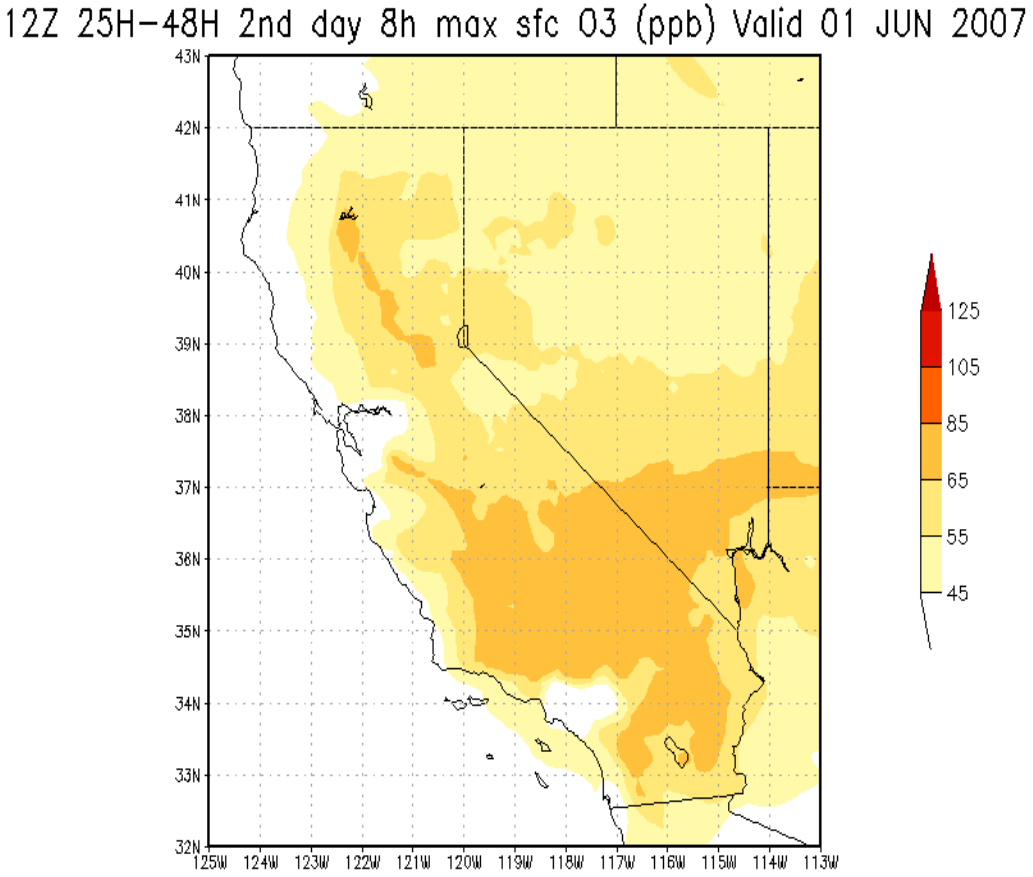
South Coast Air Quality Management District
Diamond Bar, CA

Overview

- EMC NAM12-CMAQ ozone predictions evaluated for Los Angeles area application for summer 2007
- General tendencies:
  - > under-predict Metro LA & Valleys
  - > over-predict Santa Barbara/Ventura
  - > over-predict northern San Diego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41N
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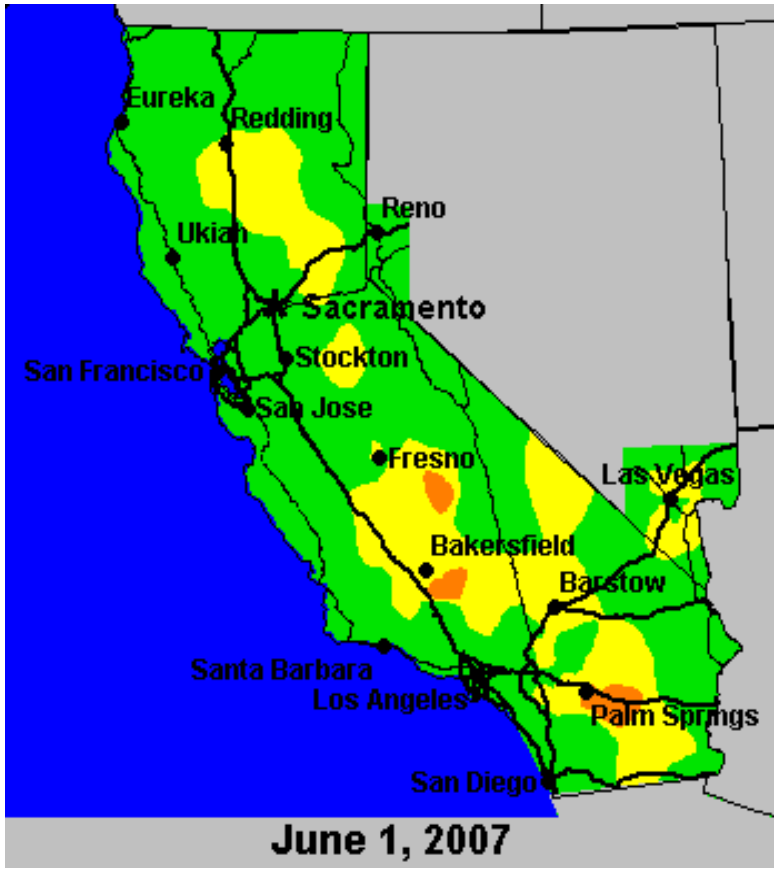
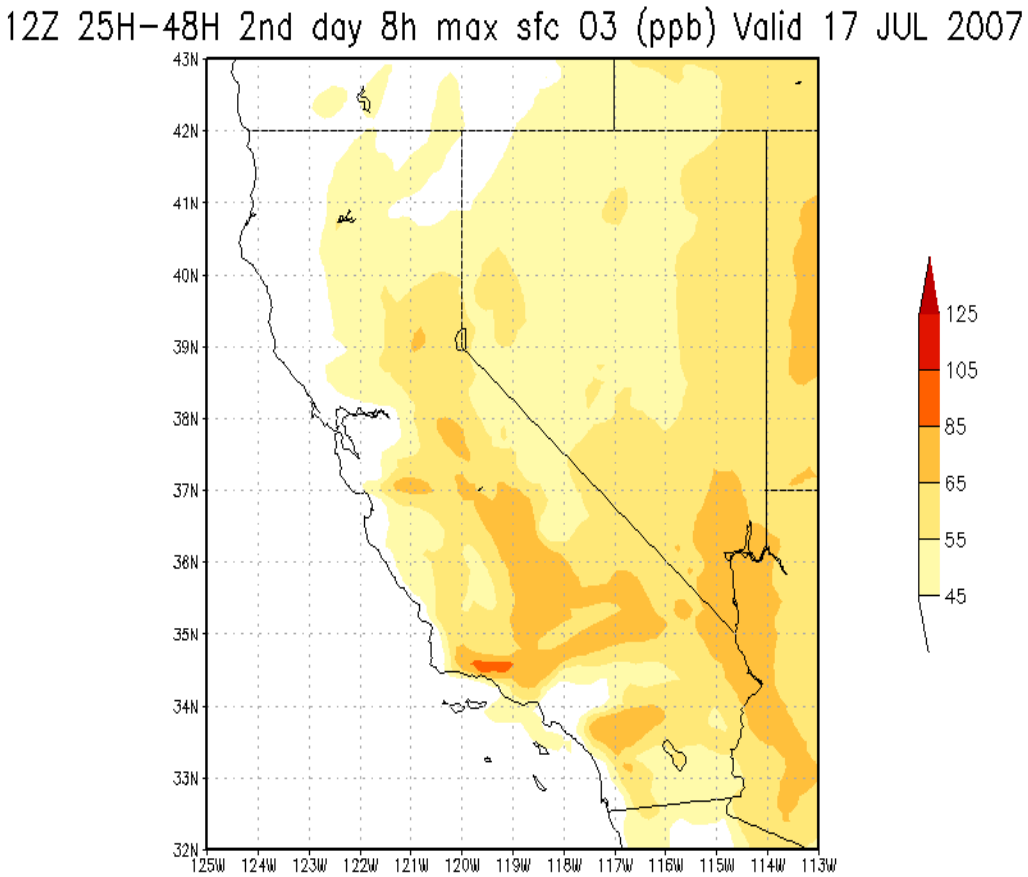

Eureka
Redding
Reno
Ukiah
Sacramento
San Francisco
Stockton
San Jose
Fresno
Las Vegas
Bakersfield
Barstow
Santa Barbara
Los Angeles
Palm Springs
San Diego
June 1, 2007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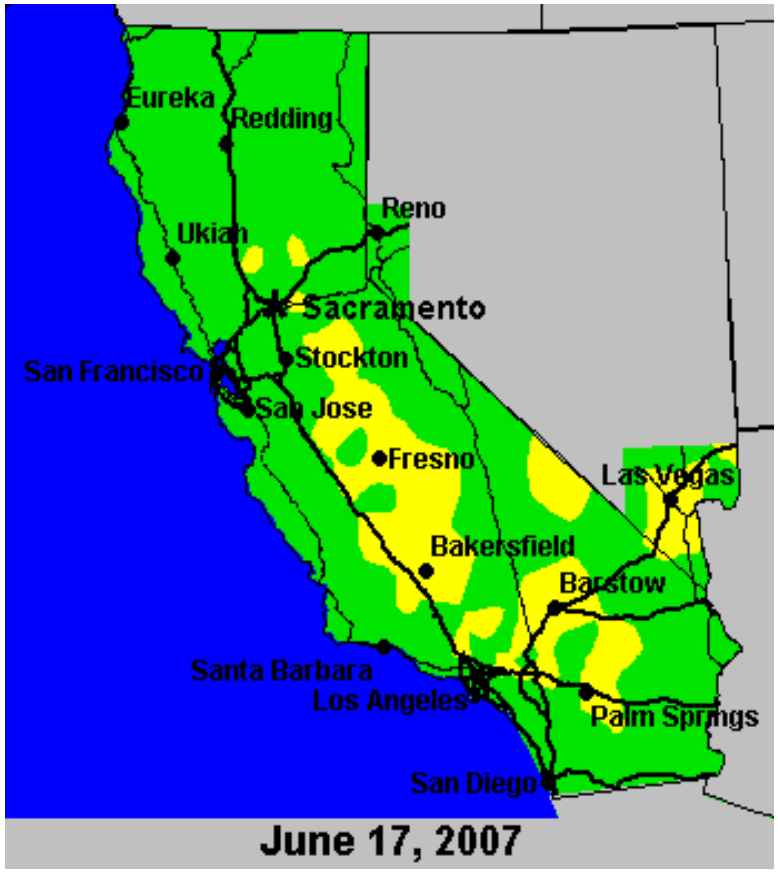
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Palm Springs
San Diego
June 17, 2007

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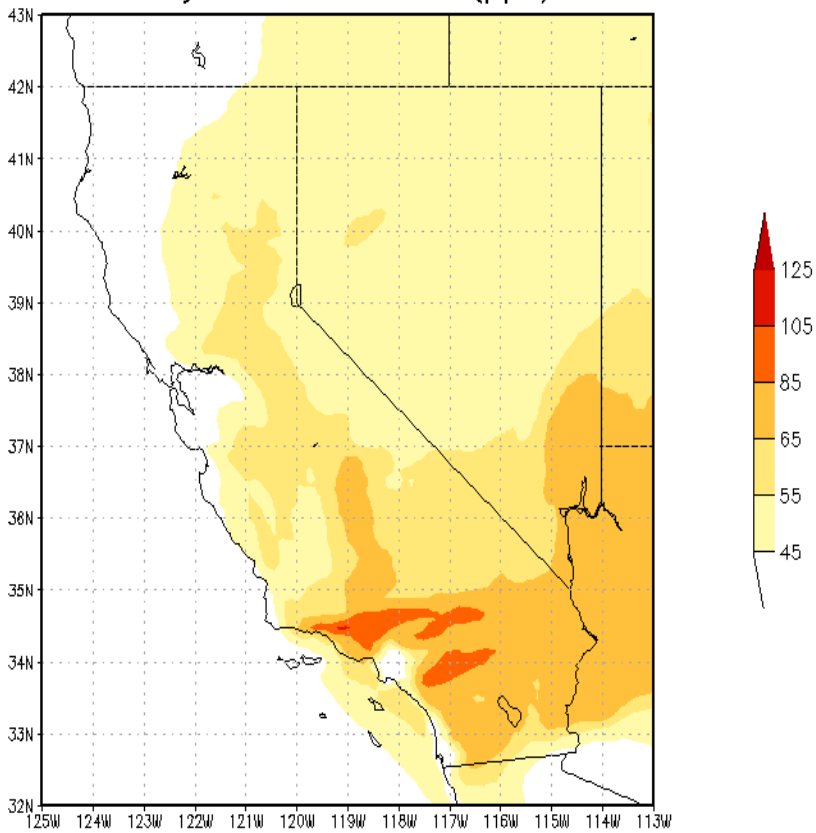

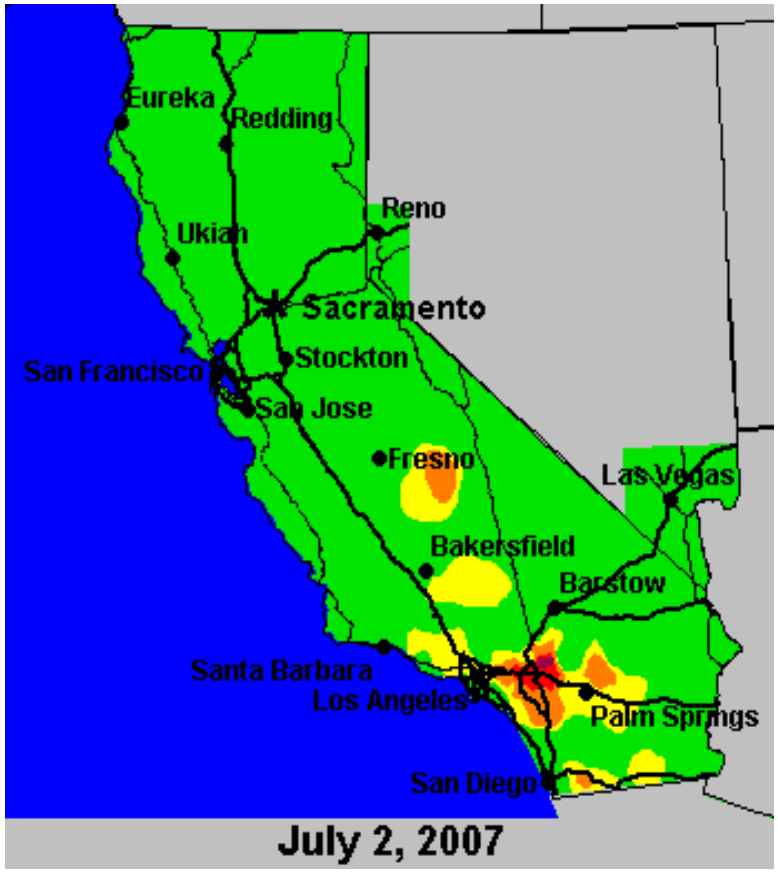

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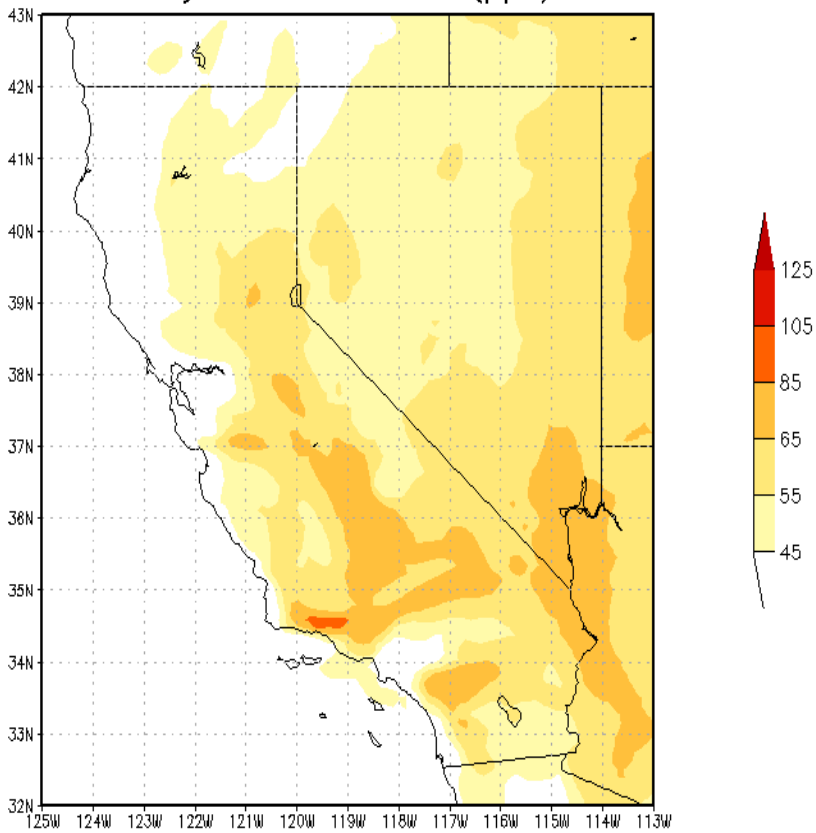

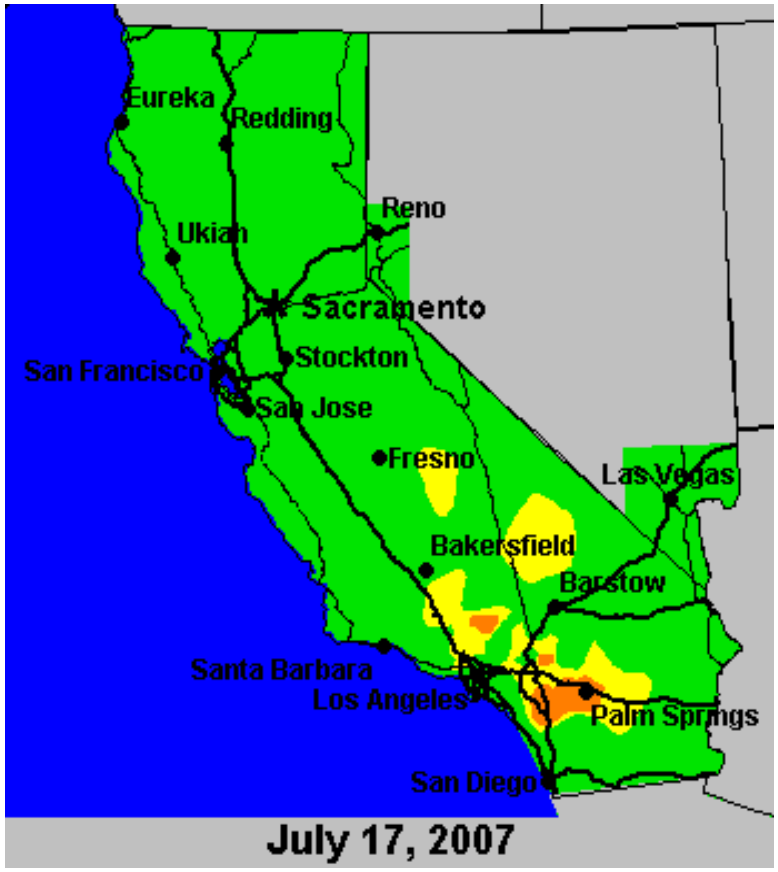

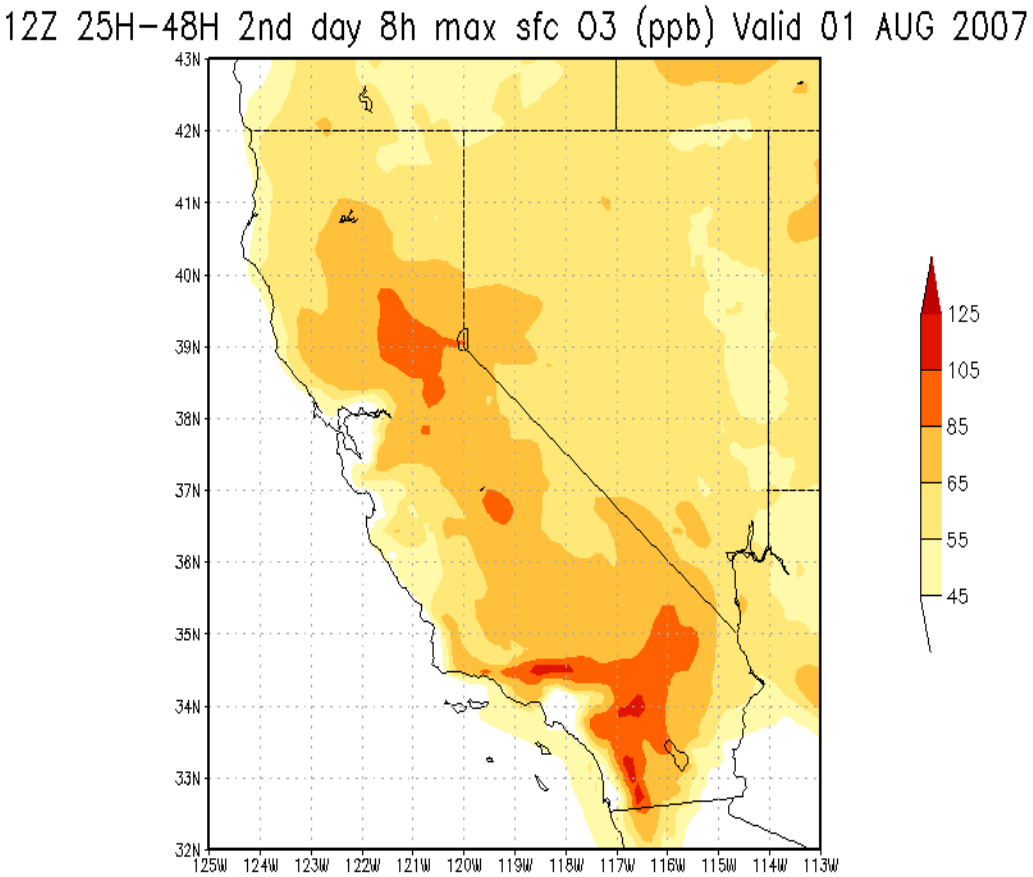
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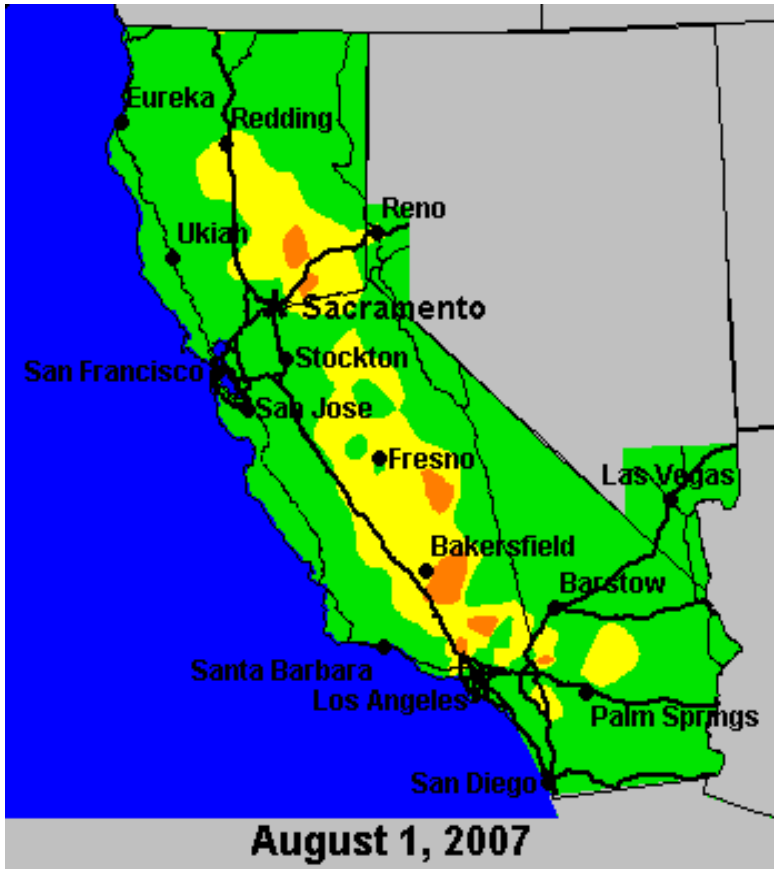
Eureka
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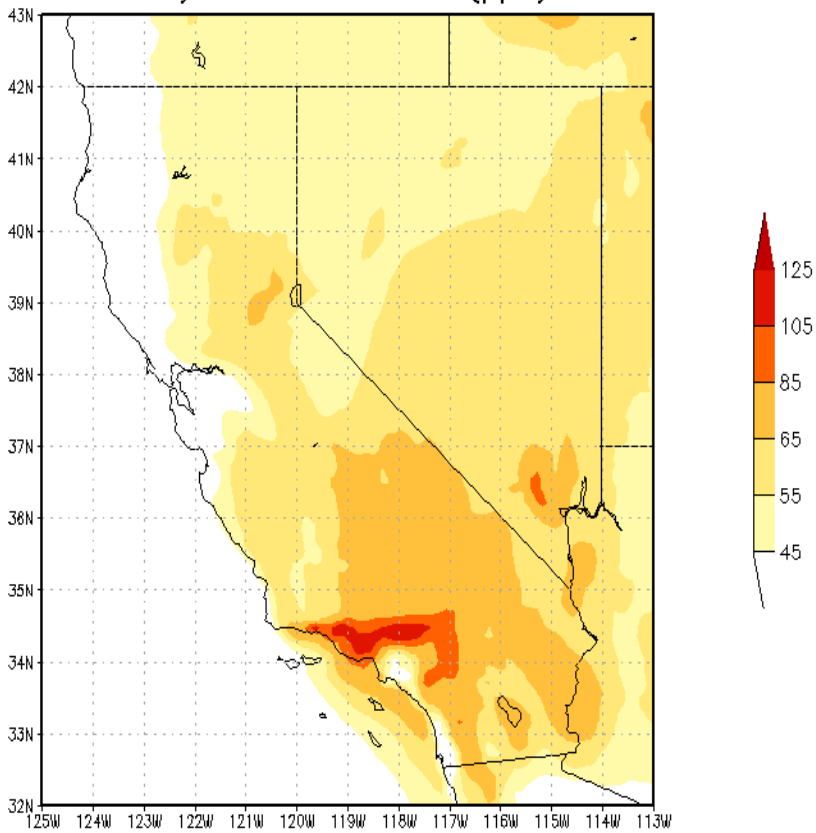
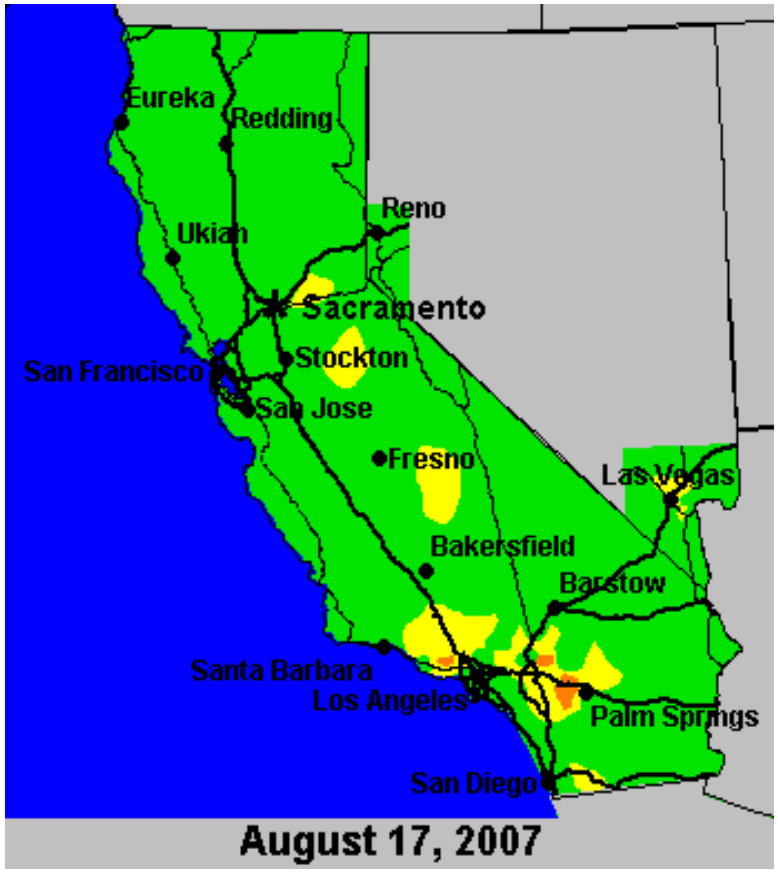
Stockton
San Jose
Fresno
Las Vegas
Bakersfield
Barstow
Santa Barbara
Los Angeles
Palm Springs
San Diego
August 1, 2007

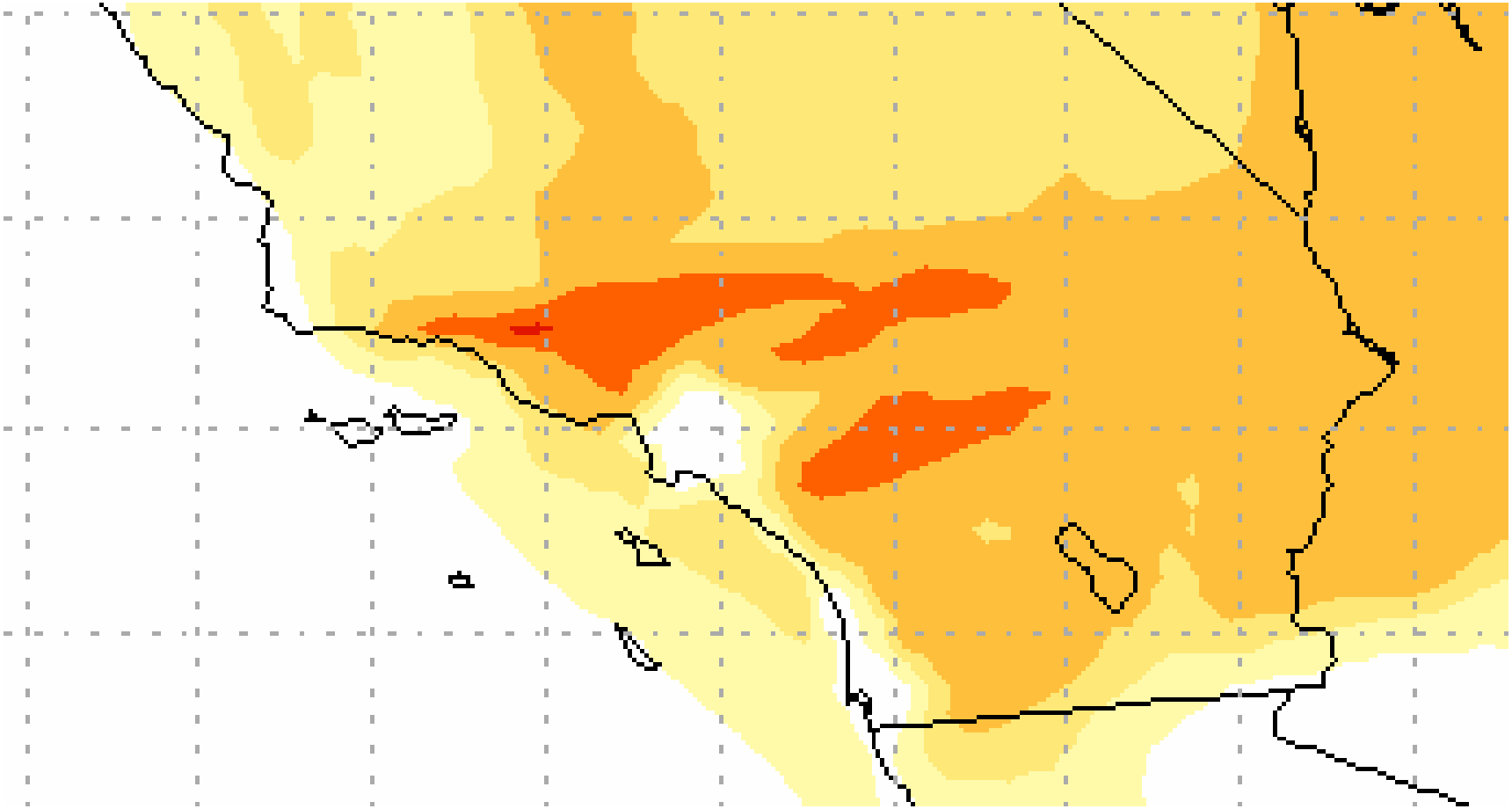
12Z 25H-48H 2nd day 8h max sfc O3 (ppb) Valid 17 AUG 2007



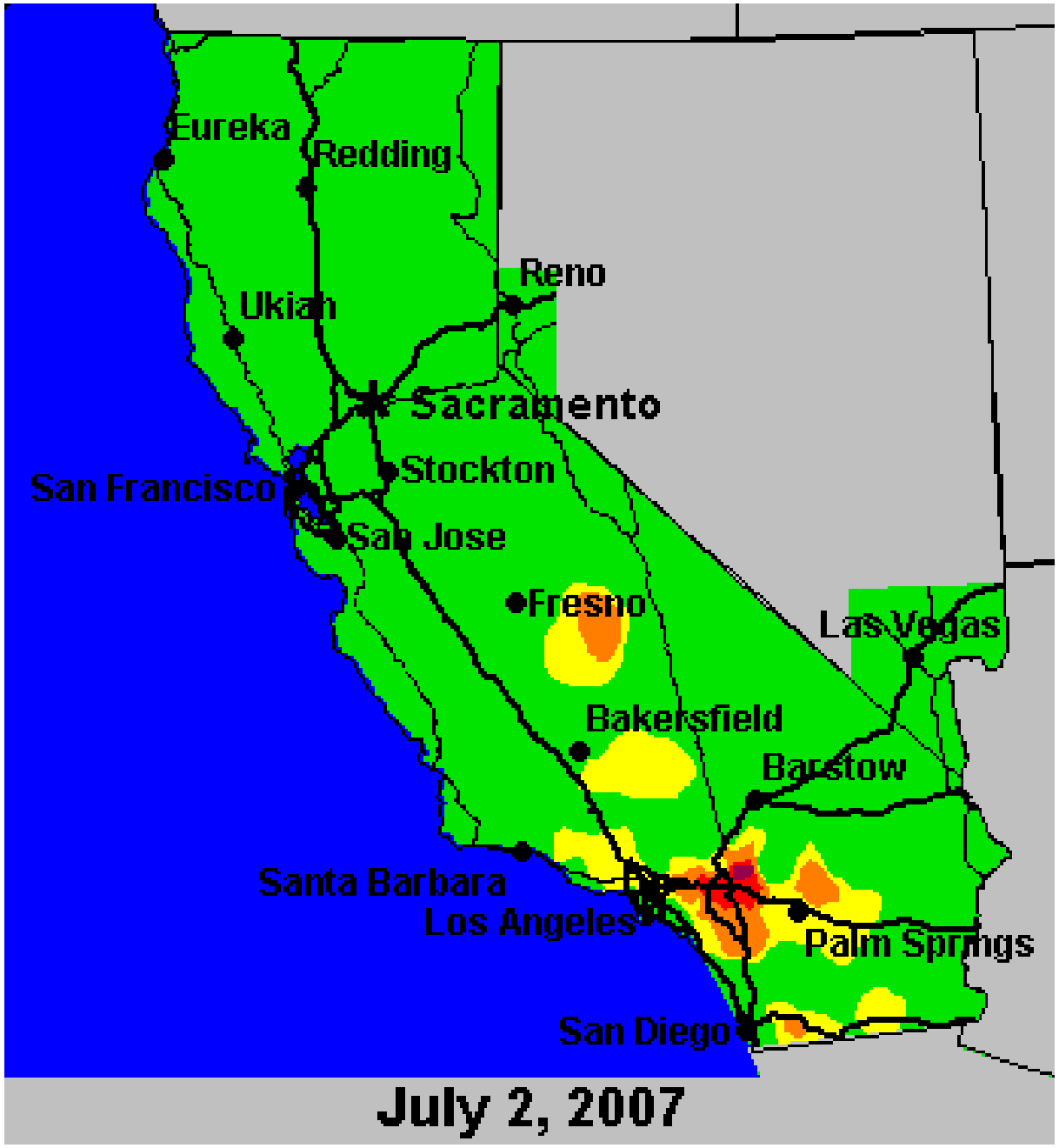


Focus on Southern California: July 2, 2007

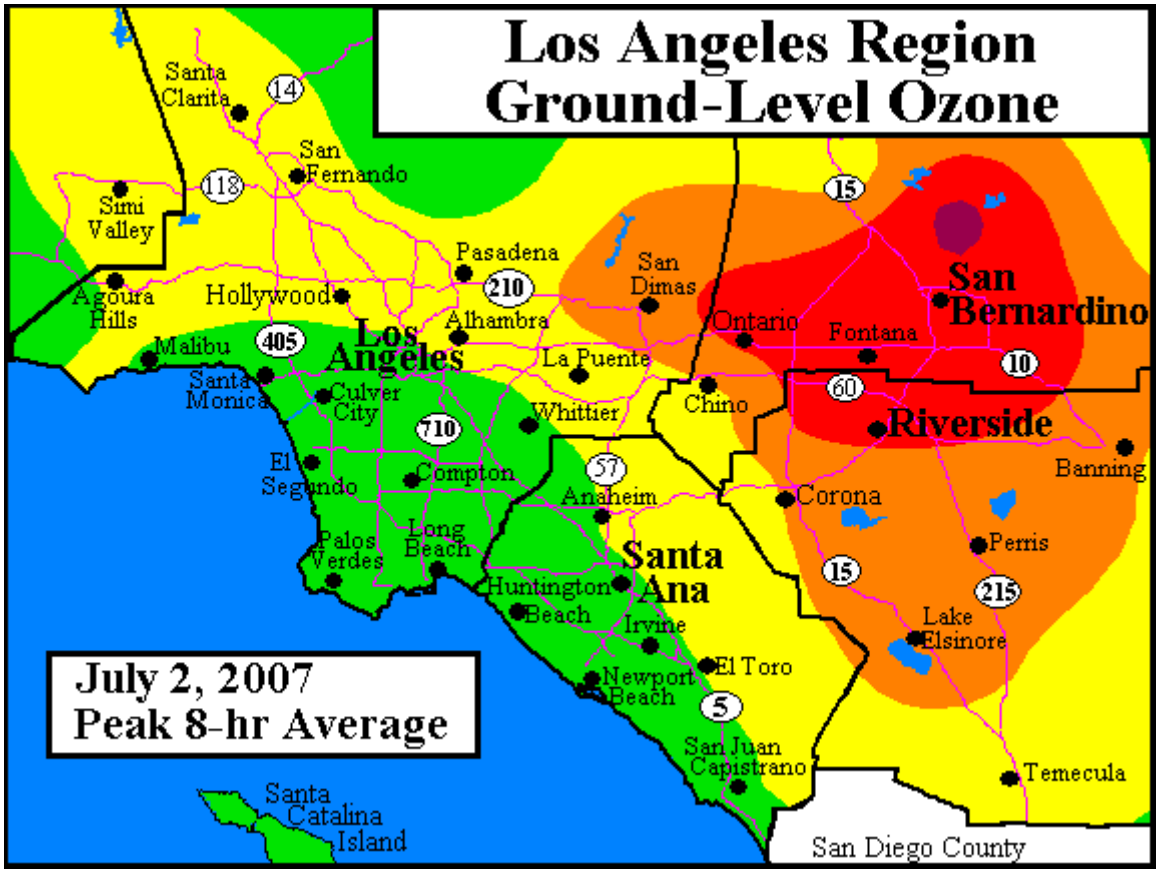
EMC NAM12-CMAQ 8-Hour Avg. Ozone Prediction for July 2, 2007



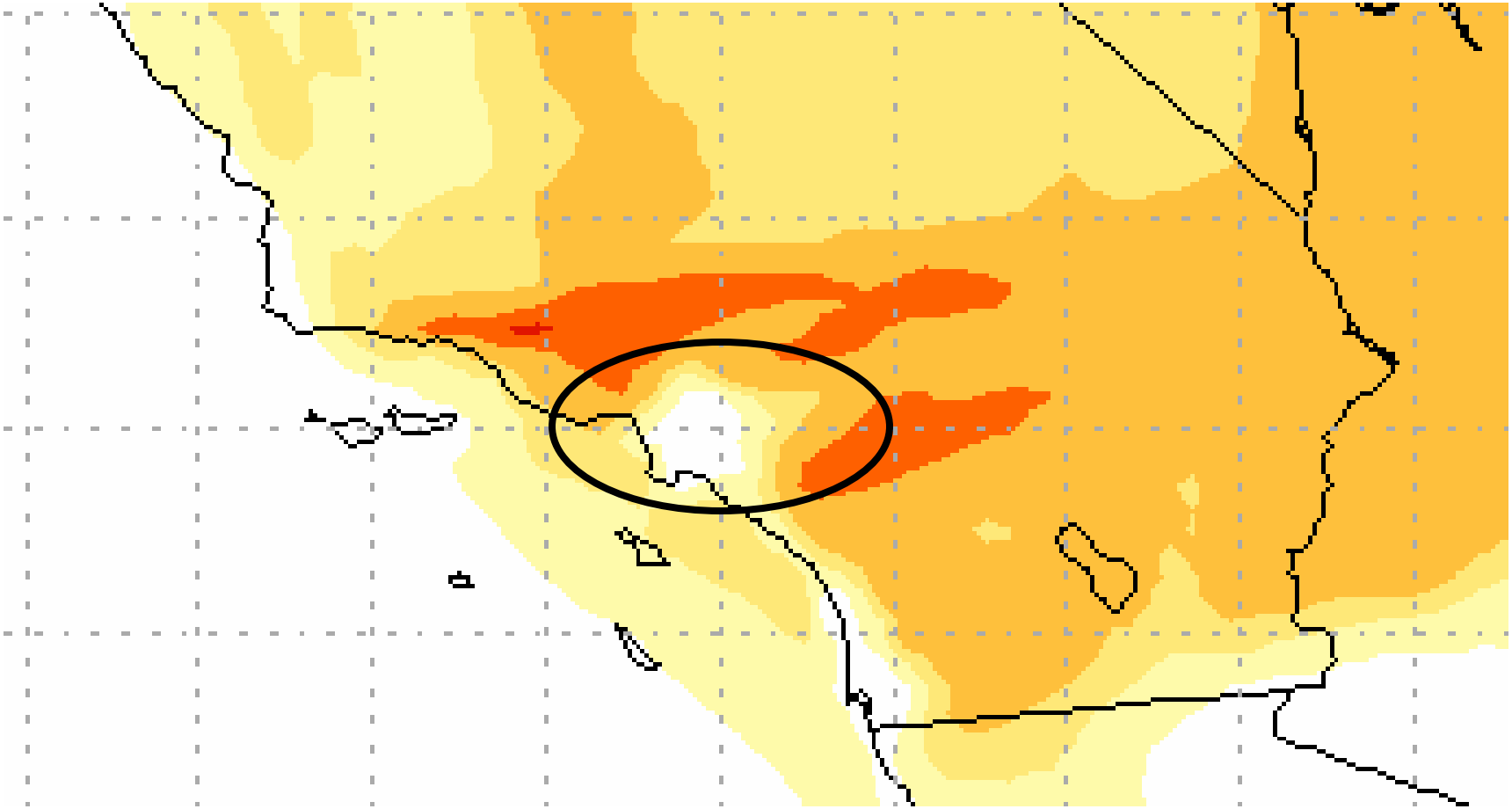
AirNow Archives



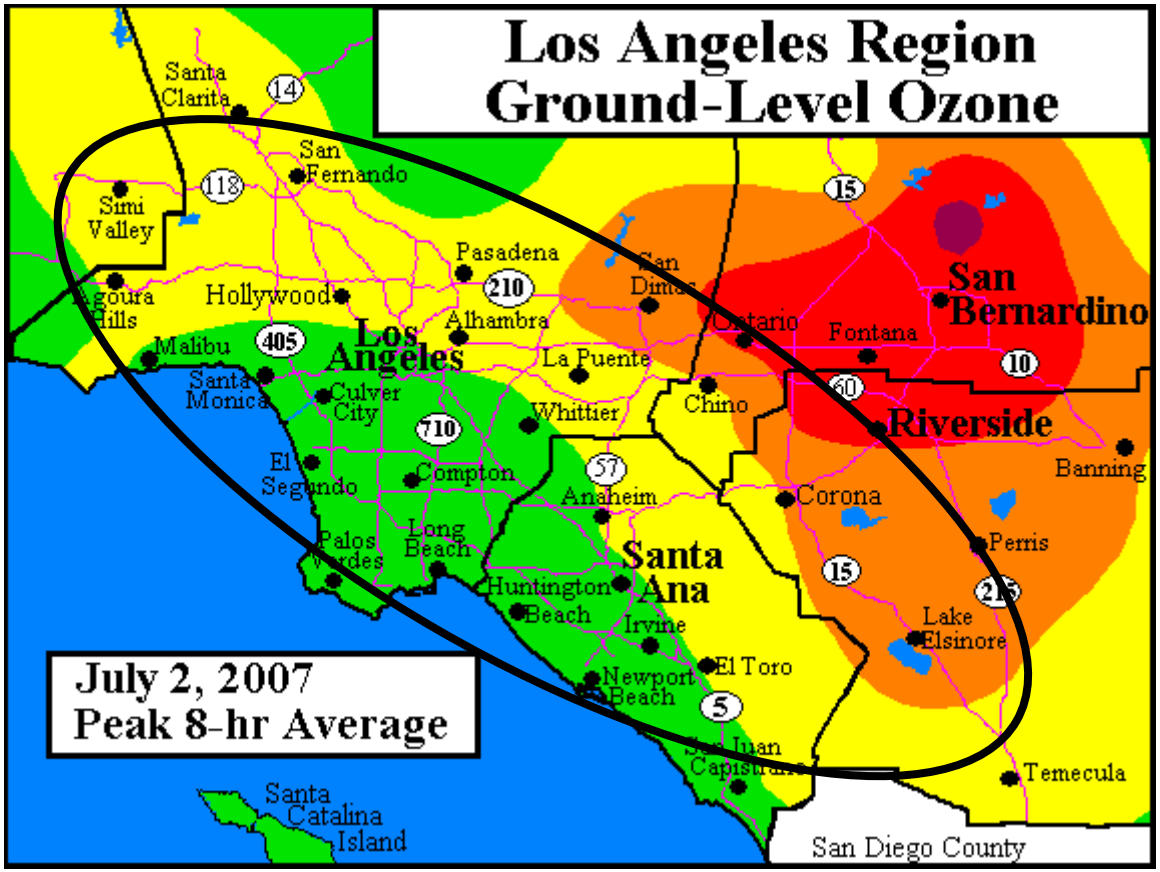
AirNow: July 2, 2007



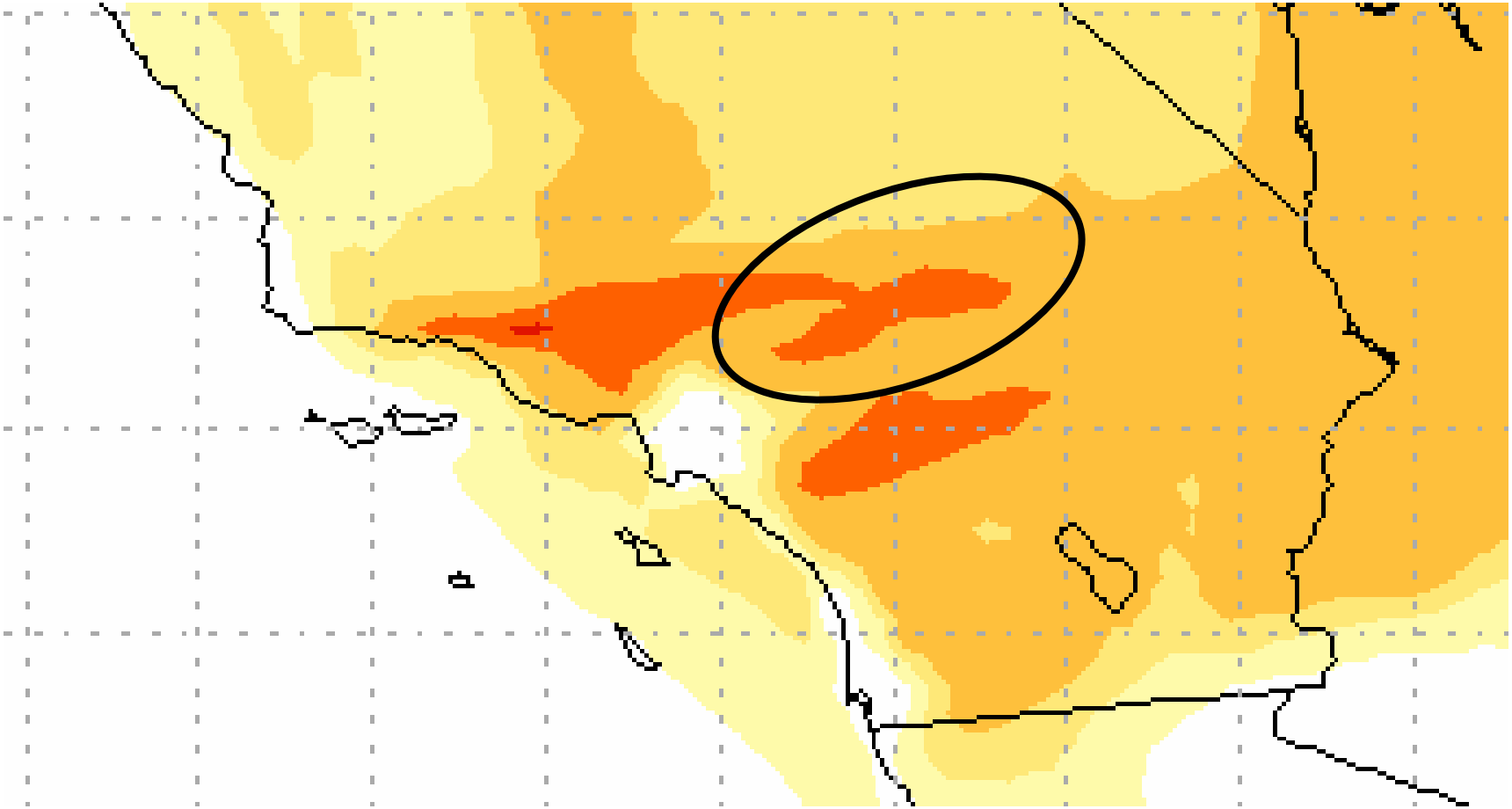
East-west ozone “hole” predicted over Los Angeles and San Gabriel Valley



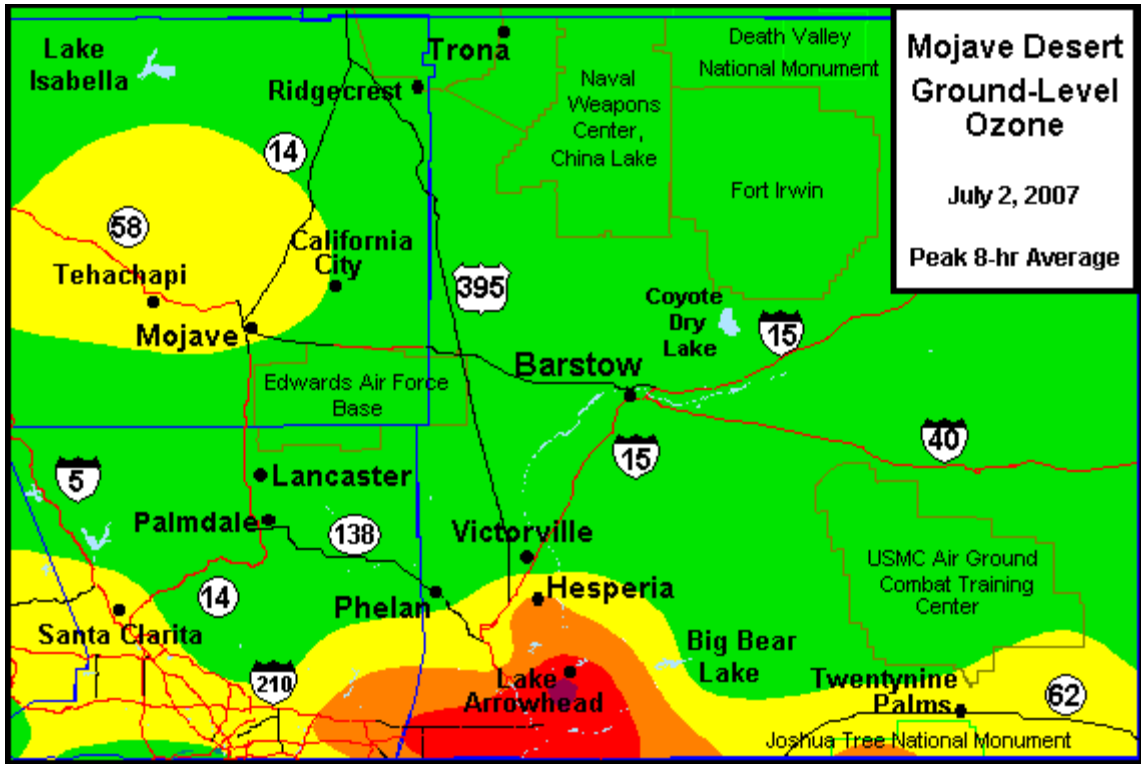
NOx Titration is Limited to the Coastal Plain



Over-prediction in the Mojave Desert

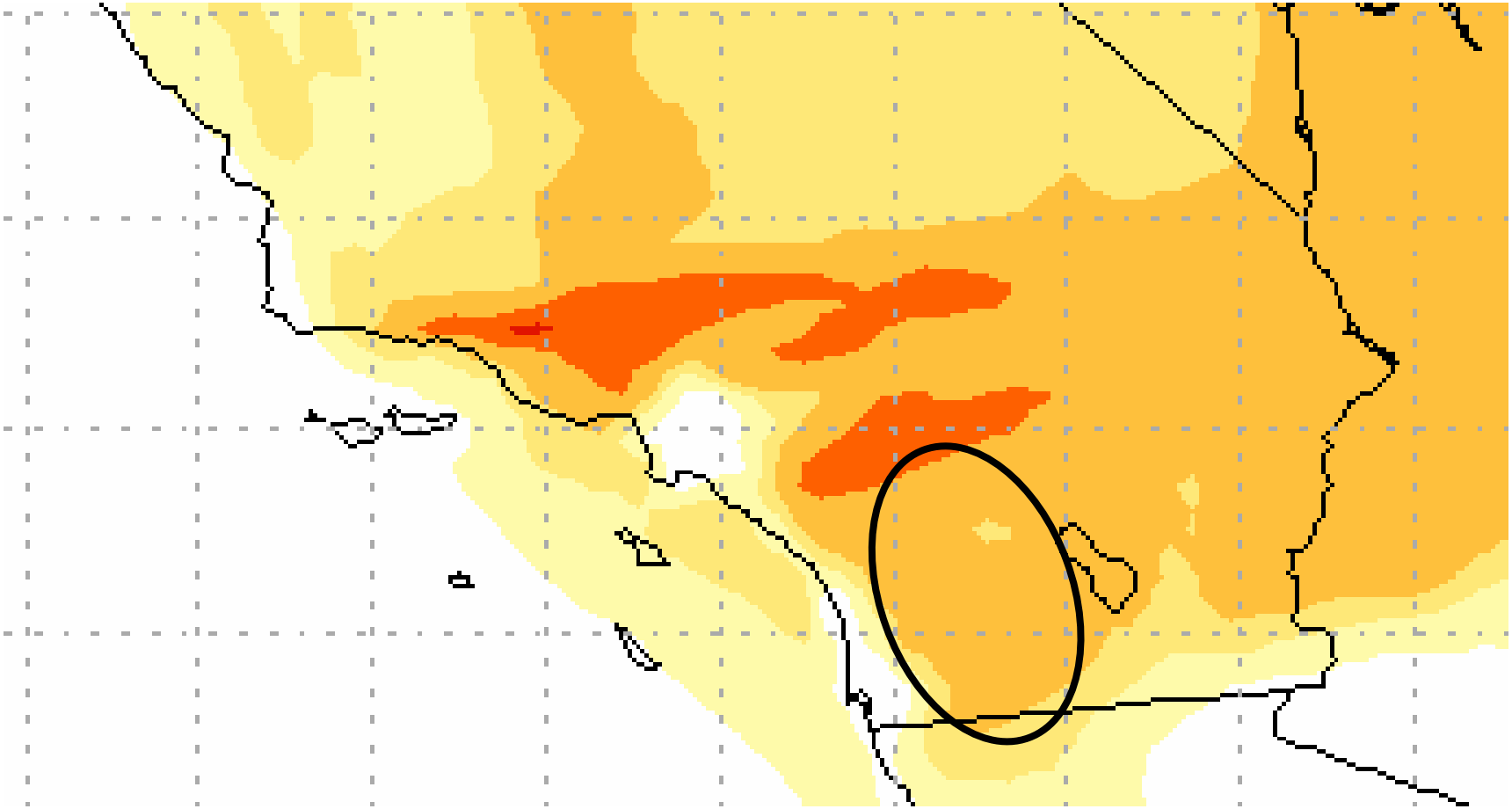


Mojave Desert Ozone: July 2, 2007

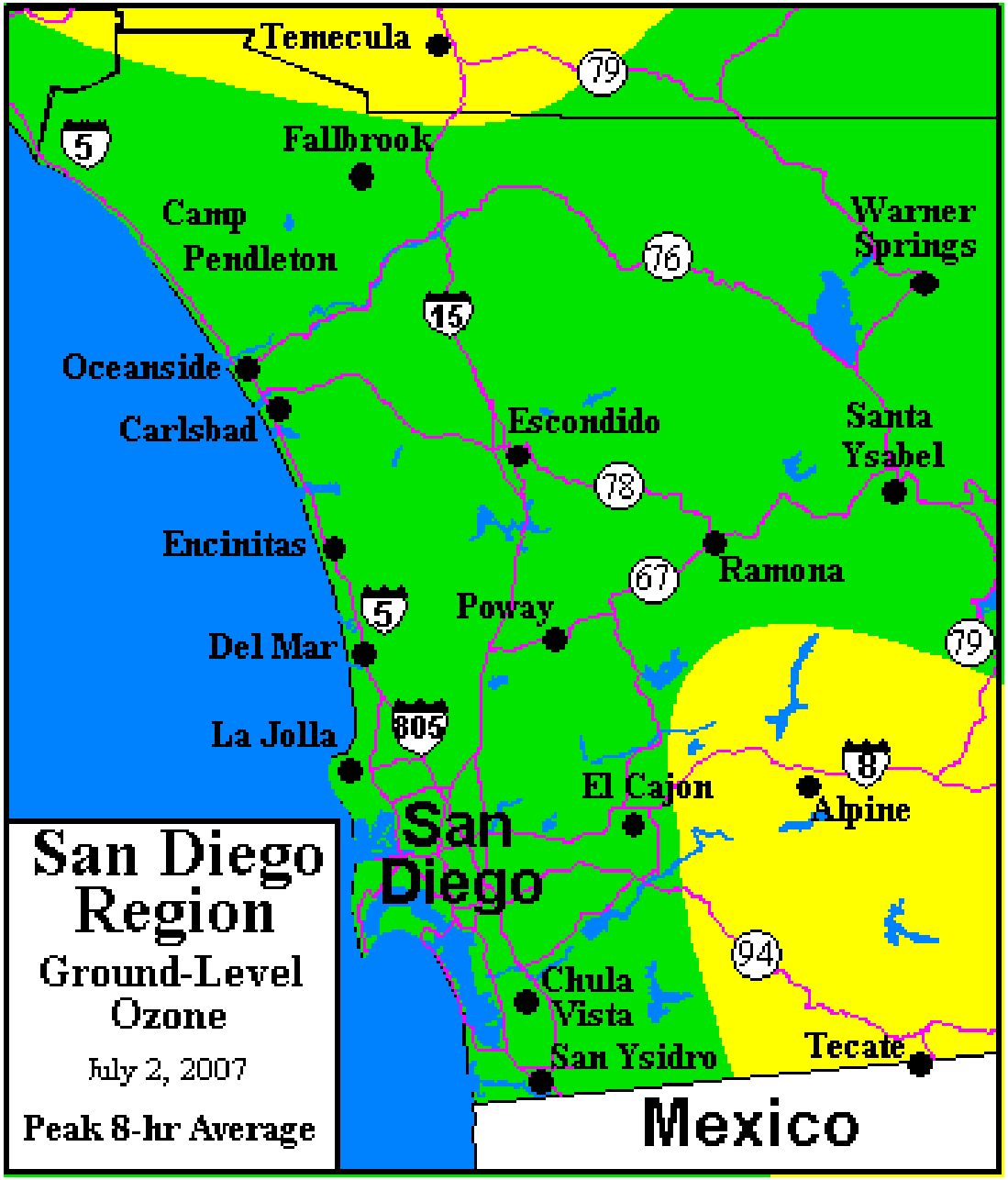


Transport of higher ozone concentrations are limited to the southern portion of the domain

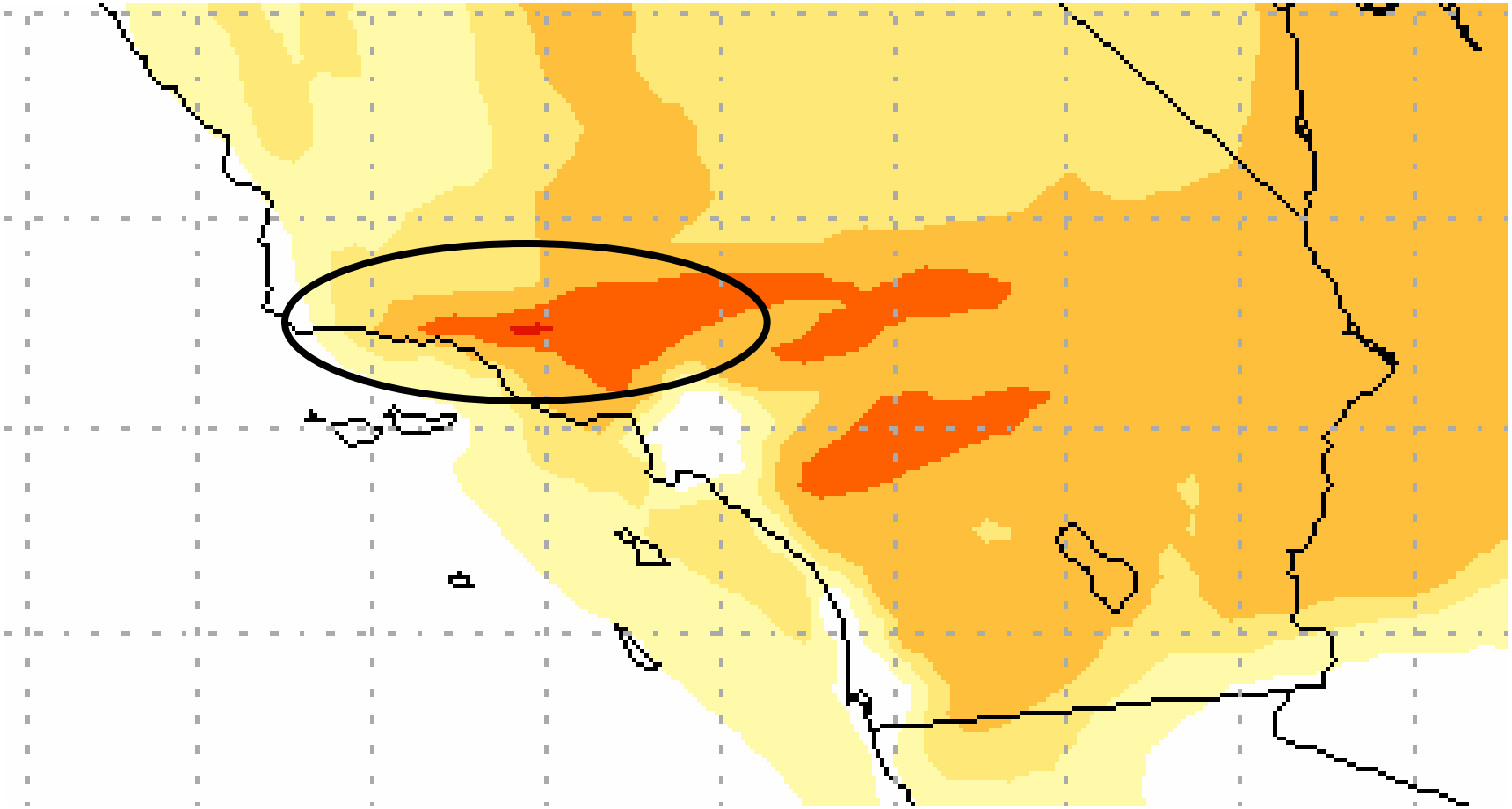
Over-prediction in Northern San Diego



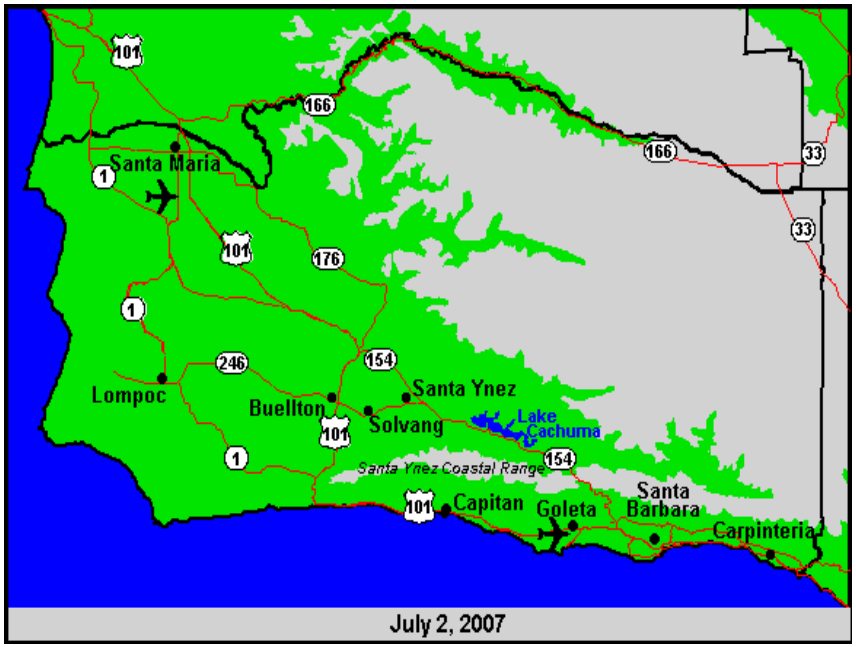
Observed ozone limited from Northern San Diego to Orange and Riverside Counties

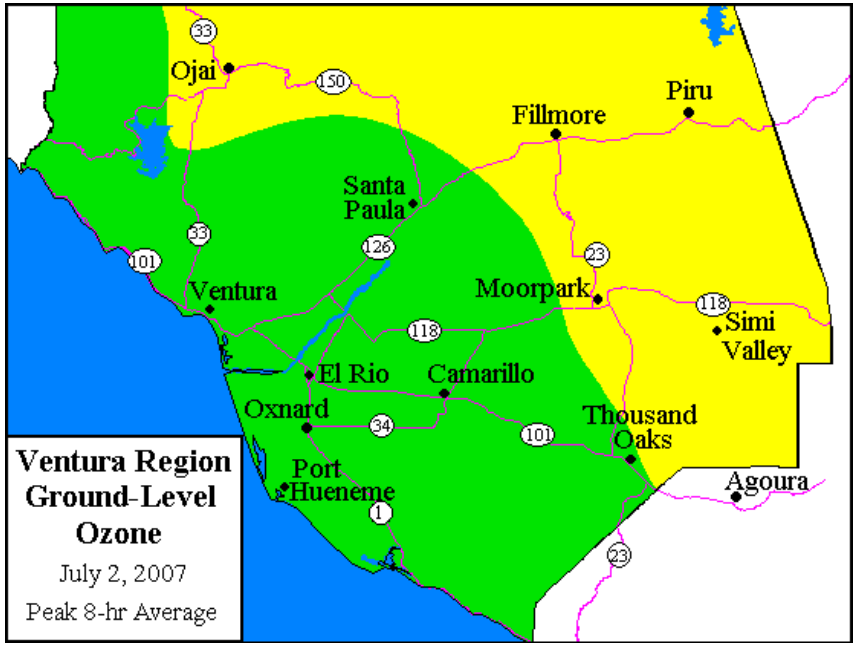


Over-prediction in Santa Barbara & Ventura



Elongated simulated ozone impact not observed in northern domain





Santa Barbara:
Below Standard

Limited ozone formation
in Eastern Ventura

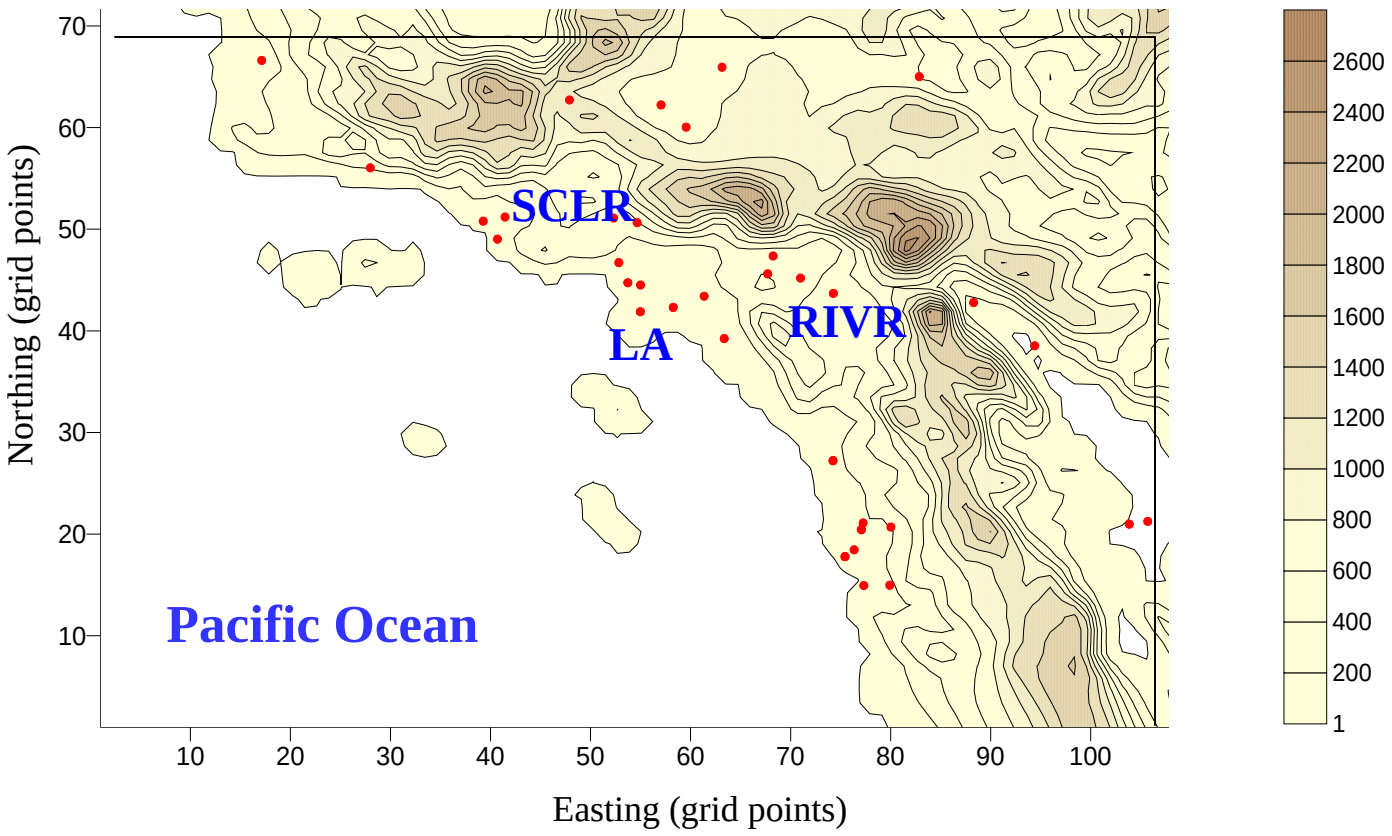
Contributing Factors to Model Performance

- Topography
- Grid Scale
- Land Use
- Emissions Inventory and Spatial Distribution

Impact of Topography

- California = Complex Terrain
- South Coast Air Basin
  - > western boundary ocean
  - > eastern boundary deserts (high & low)
  - > elongated coastal plain
  - > 4-major valley systems
  - > urban/wildland interface (1000 – 11,000 feet)
- Larger grid smoothes terrain

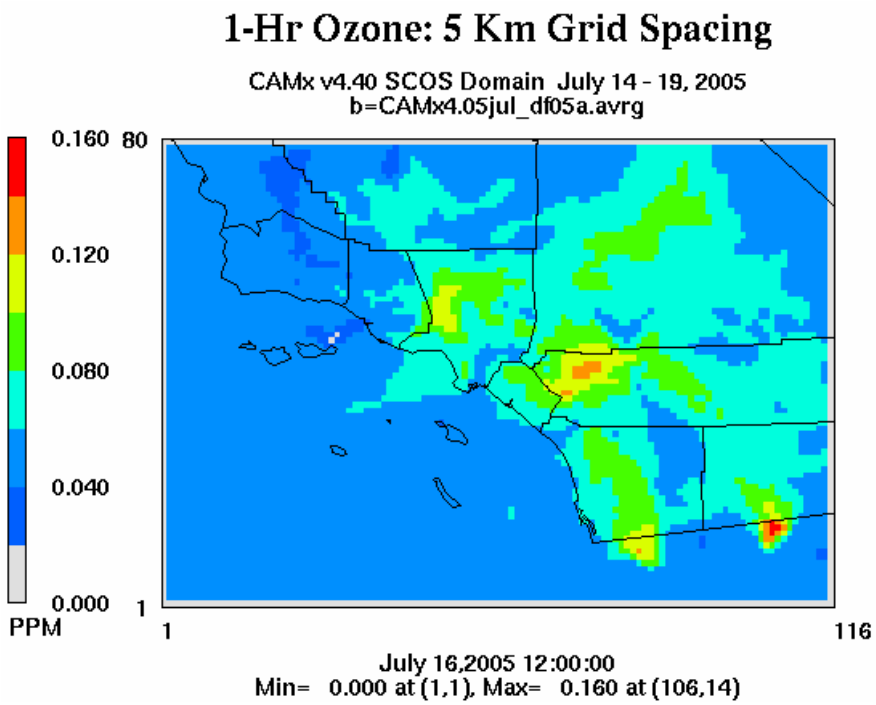
Topography

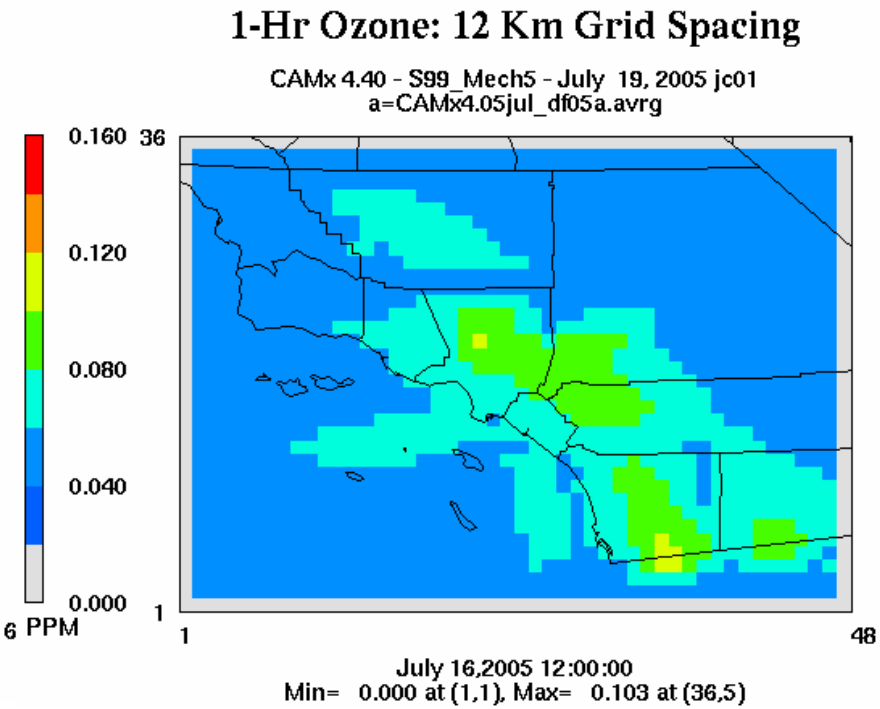

SCLR
LA
RIVR
Pacific Ocean
Northing (grid points)
Easting (grid points)
70
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90
100
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
1

Grid Scale Assessment

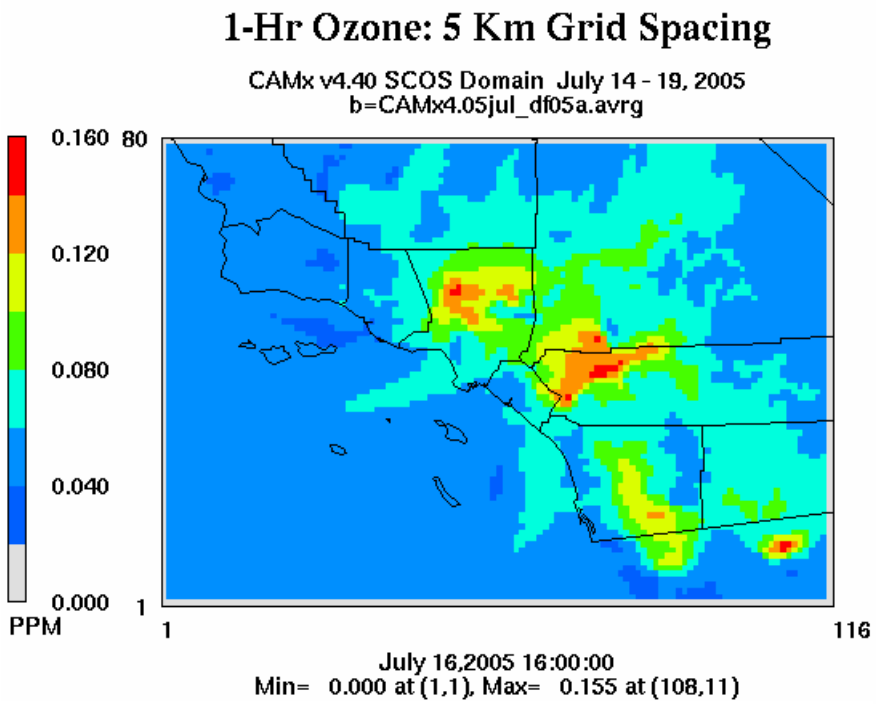
- July 16, 2005 Meteorological Episode Used For 2007 SIP Attainment Demonstration
- MM5 4DDA run for 5 & 12 km grid
- CAMx ozone simulation run for each grid scale
- Emissions re-mapped from 5 to 12 km to overlay grid

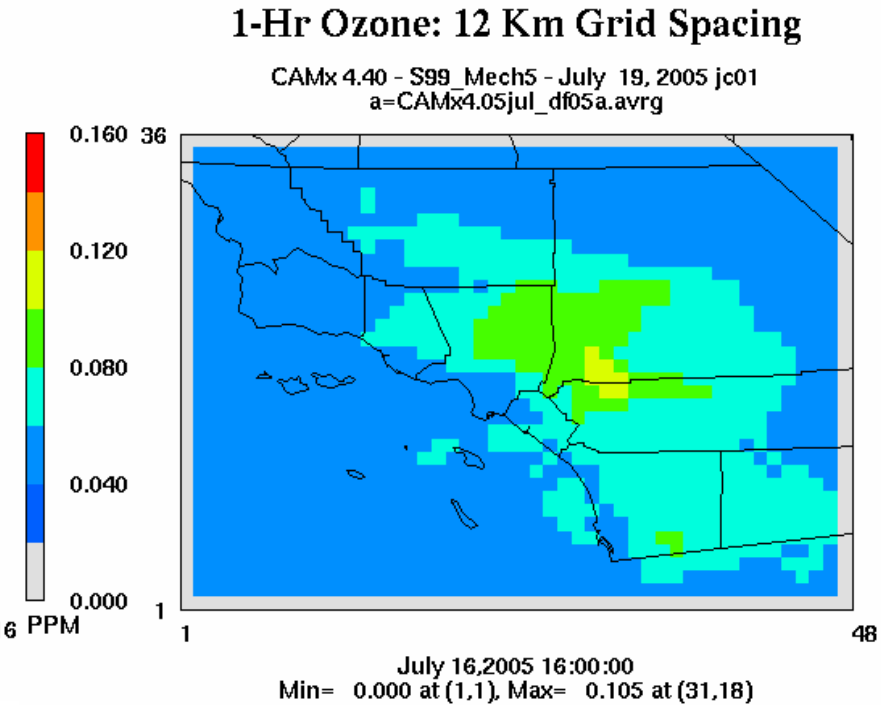
Spatial Distribution of O_3 Concentration: **1200 PST**



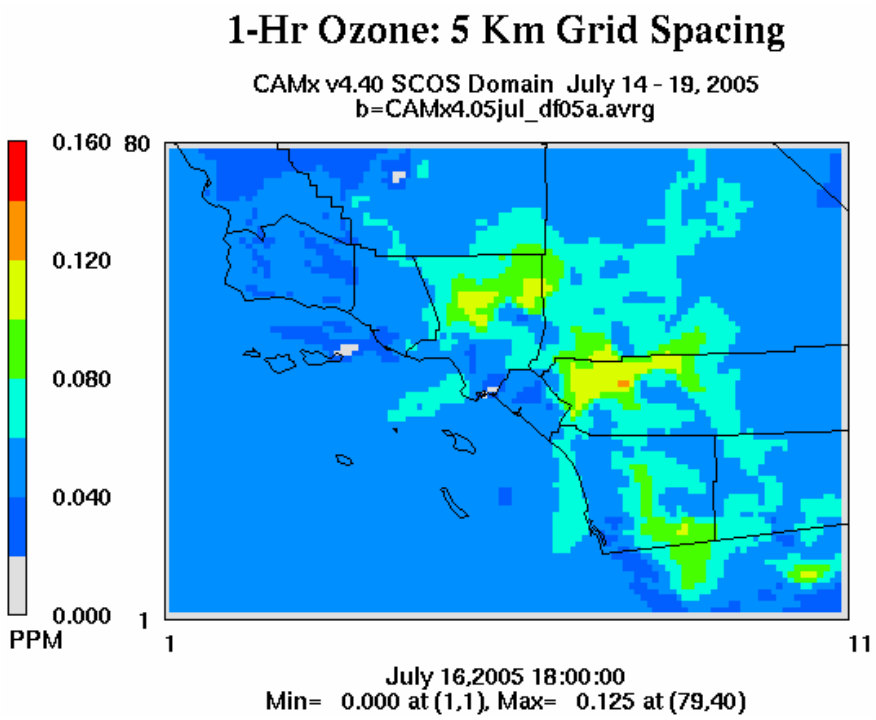


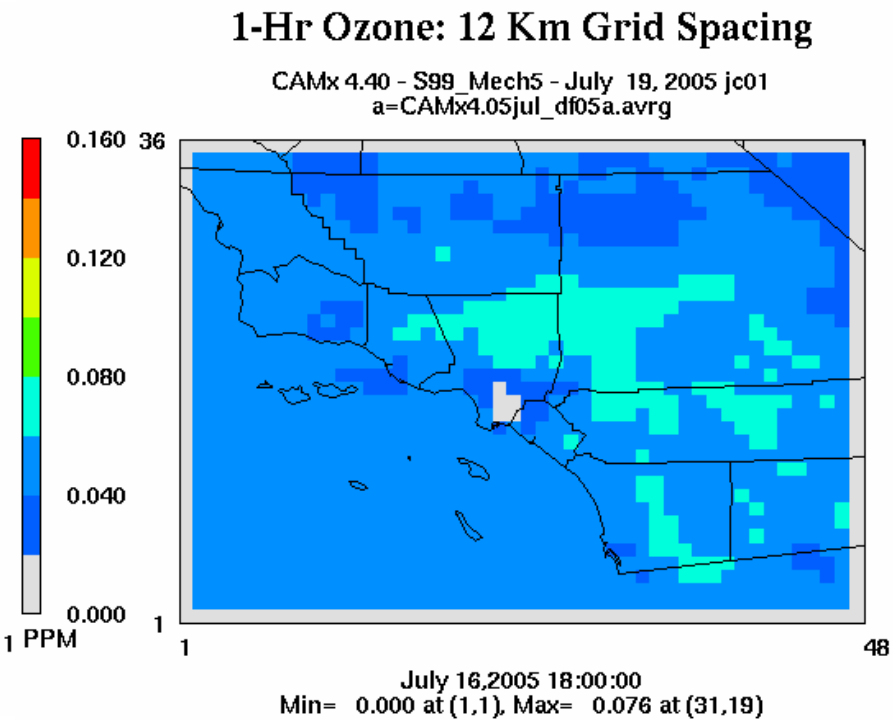
Spatial Distribution of O_3 Concentration: **1600 PST**



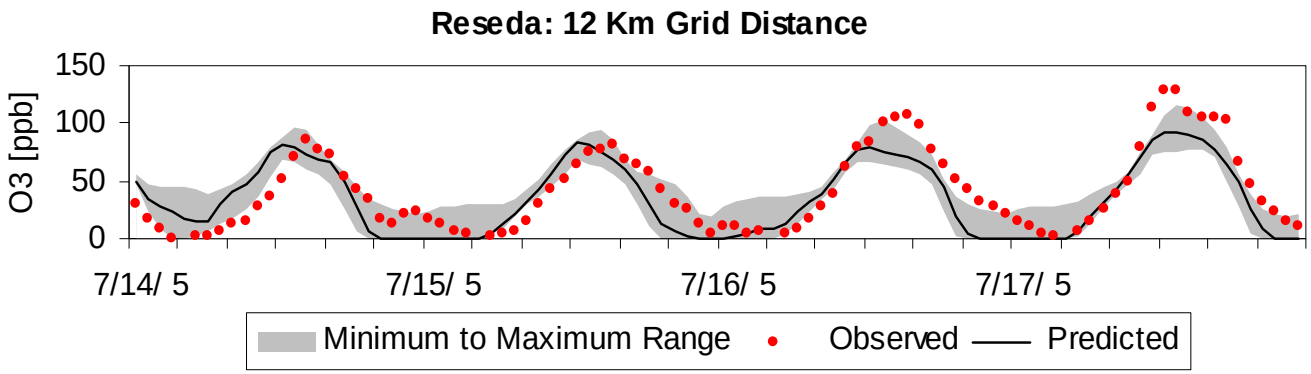


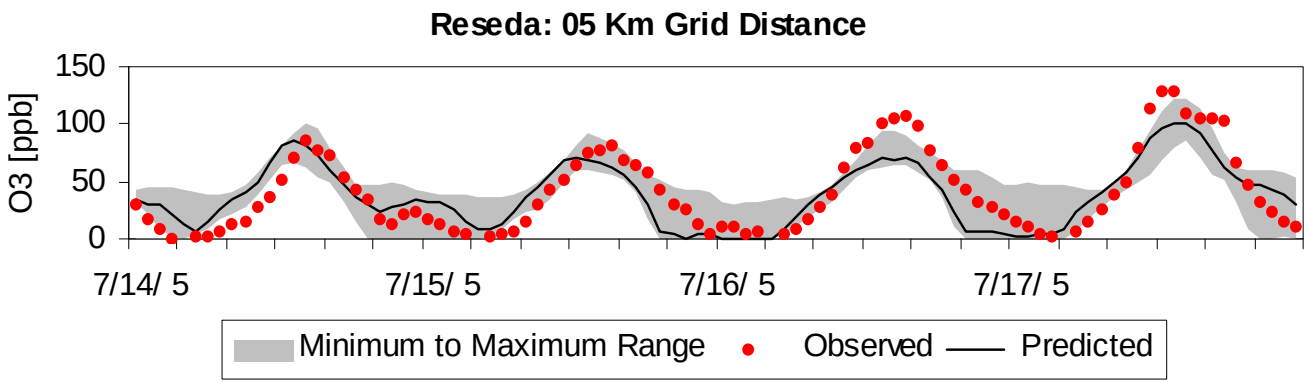
Spatial Distribution of O_3 Concentration: **1800 PST**



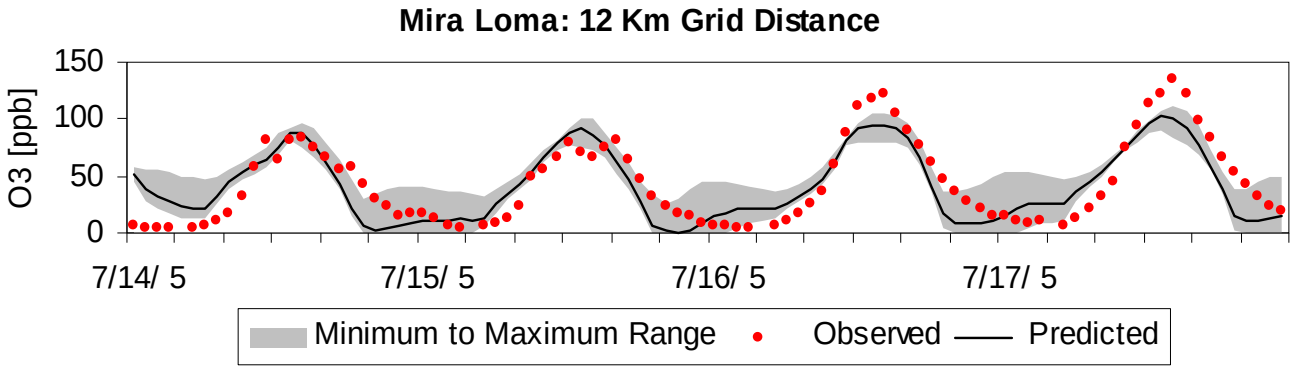


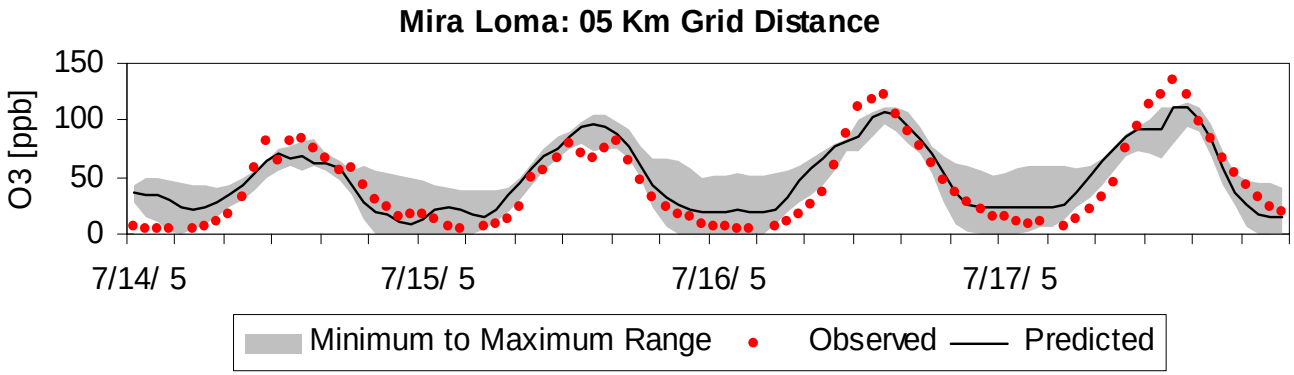
Reseda Times Series Comparisons



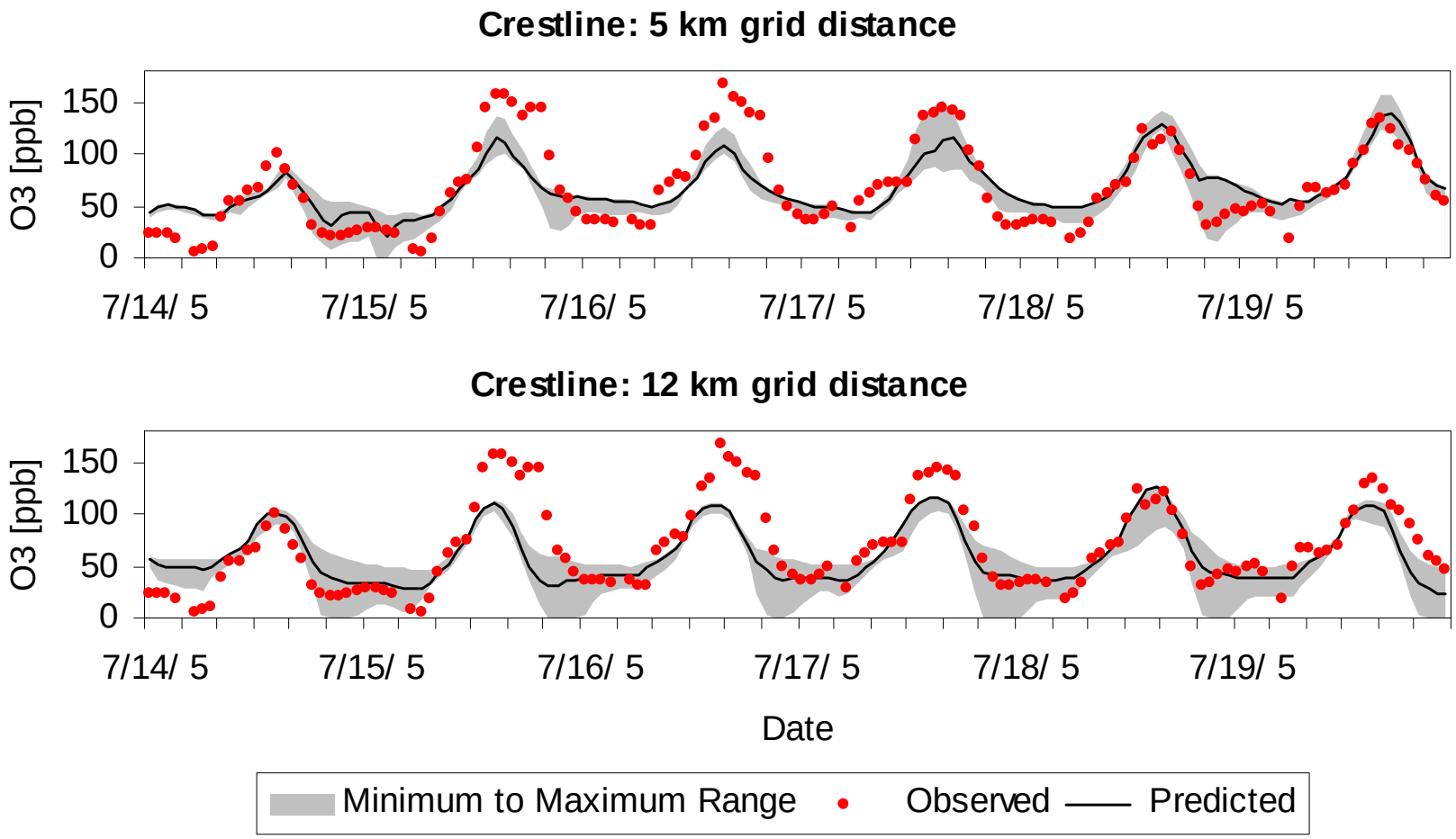


Mira Loma Times Series Comparisons

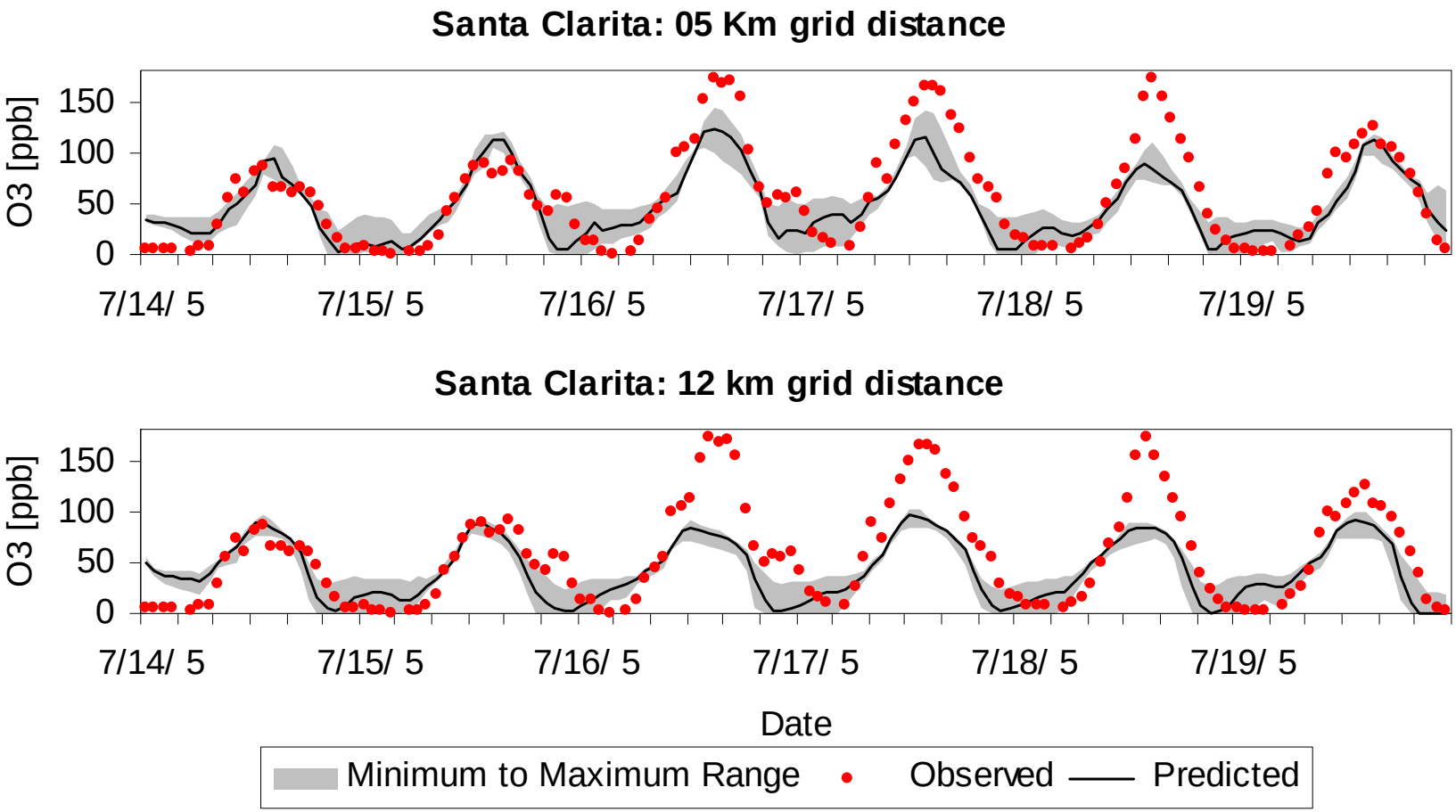




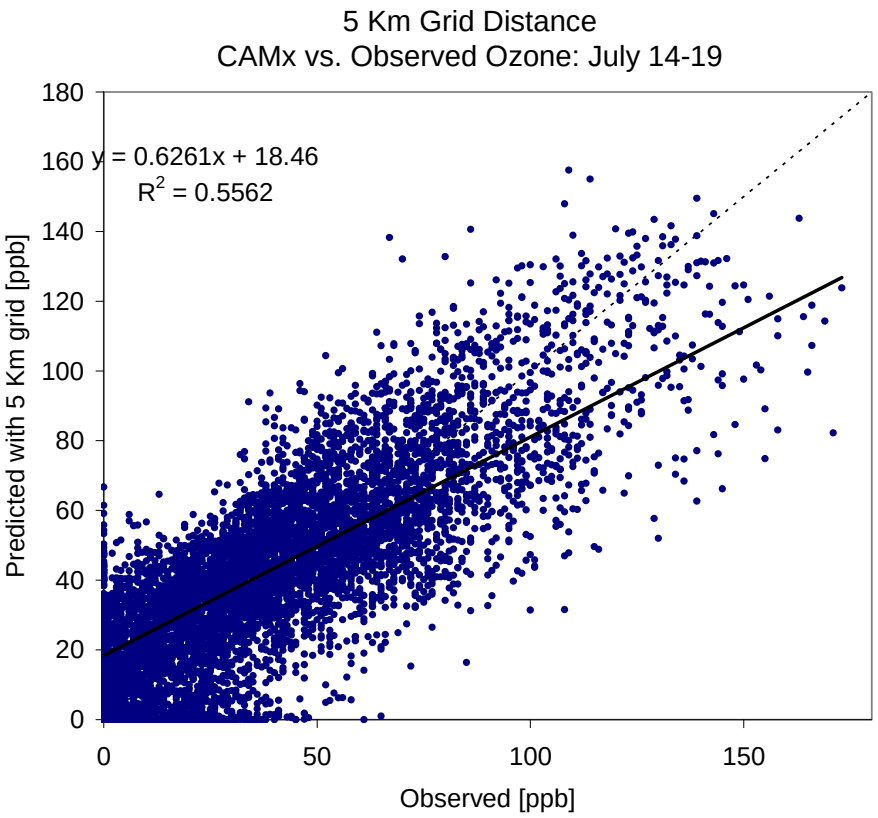
Crestline Times Series Comparisons

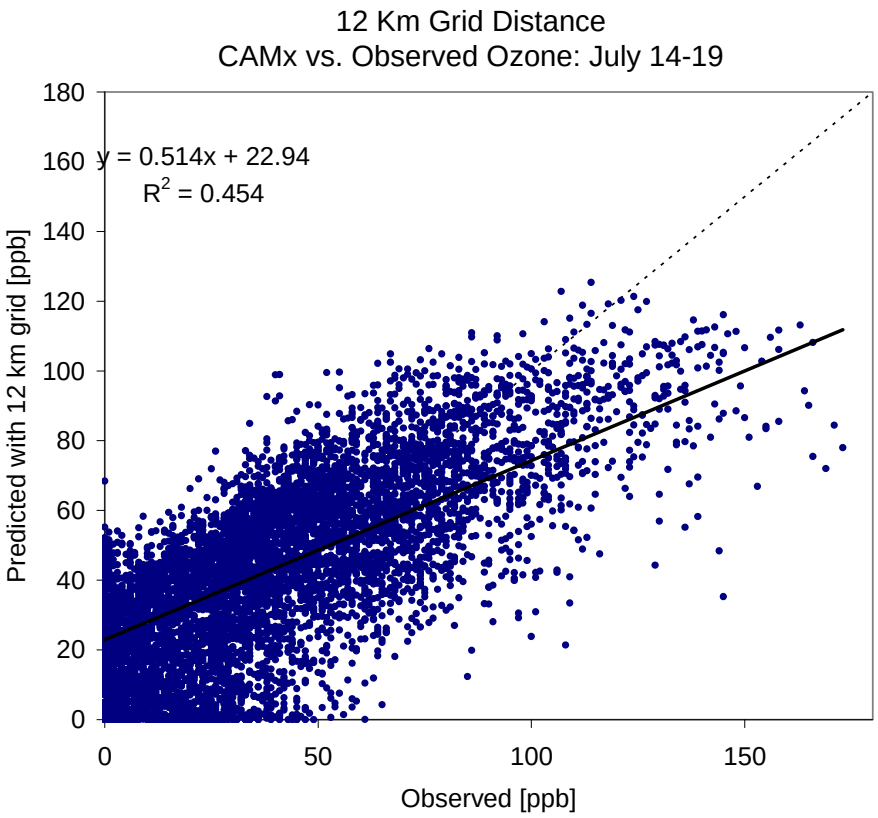


Santa Clarita Times Series Comparisons



Bivariate Analysis 5 Vs 12Km Simulations





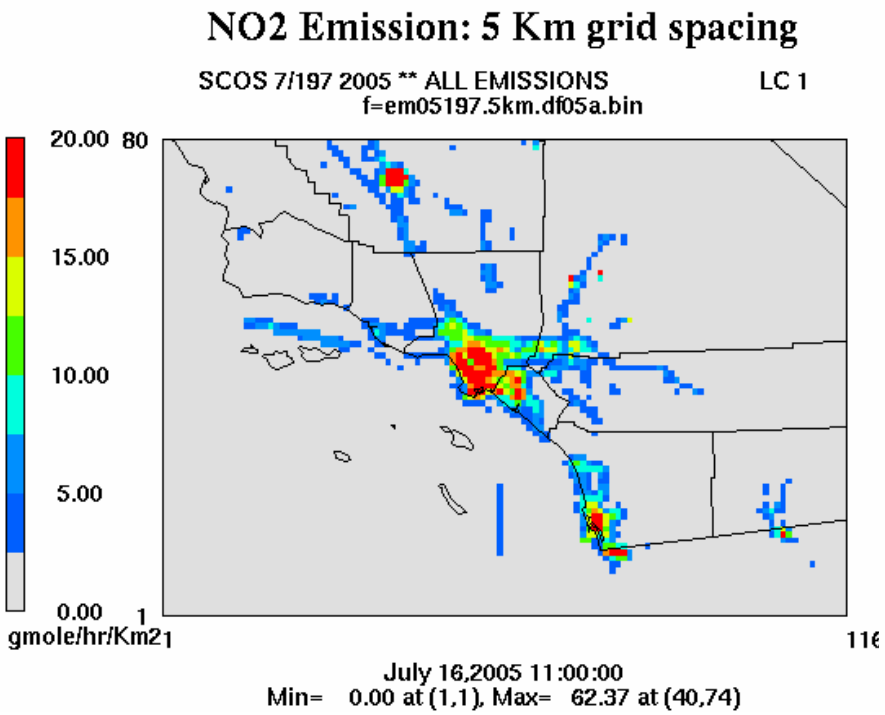
5 Km Vs 12 Km

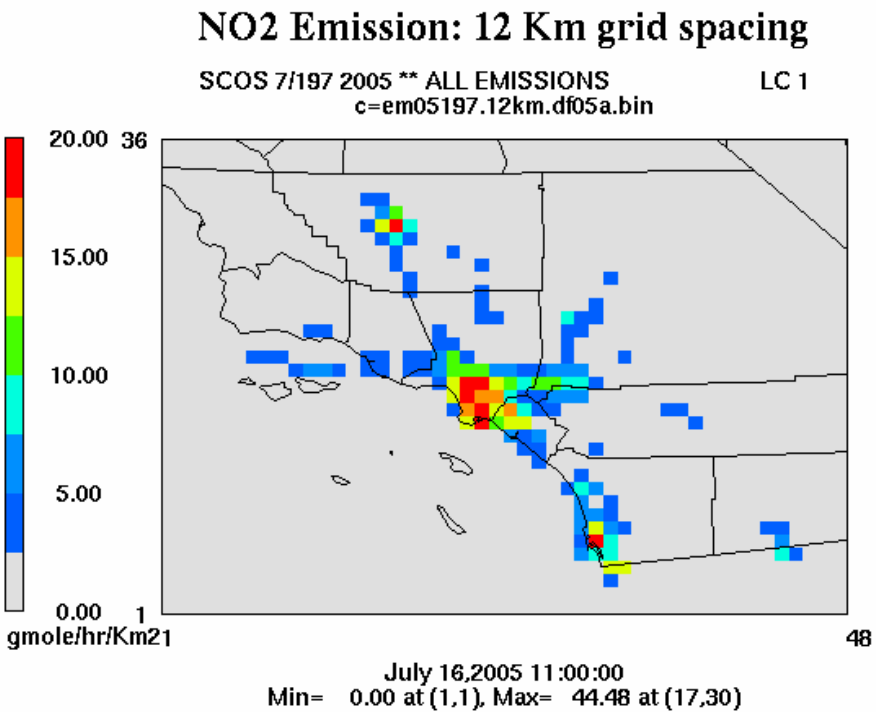
- General ozone pattern better defined with enhanced grid resolution
- Patterns are similar
- Site specific ozone concentrations in areas with observed peaks lower in 12 km analysis
- Similar predicted concentrations (5 vs. 12 km) when multi-grid averaging is used in areas of the domain experiencing little diurnal ozone variation

Re-Mapping the Emissions

- General pattern of mobile and stationary emissions maintained
- Concentrations of VOC and NOx spread over the larger grid cell
- Altered spatial VOC/NOx ratio may account for concentration differences at peak stations
- Ozone over-prediction outside of the Basin may reflect overestimate of biogenic emissions

NO_2 Emissions





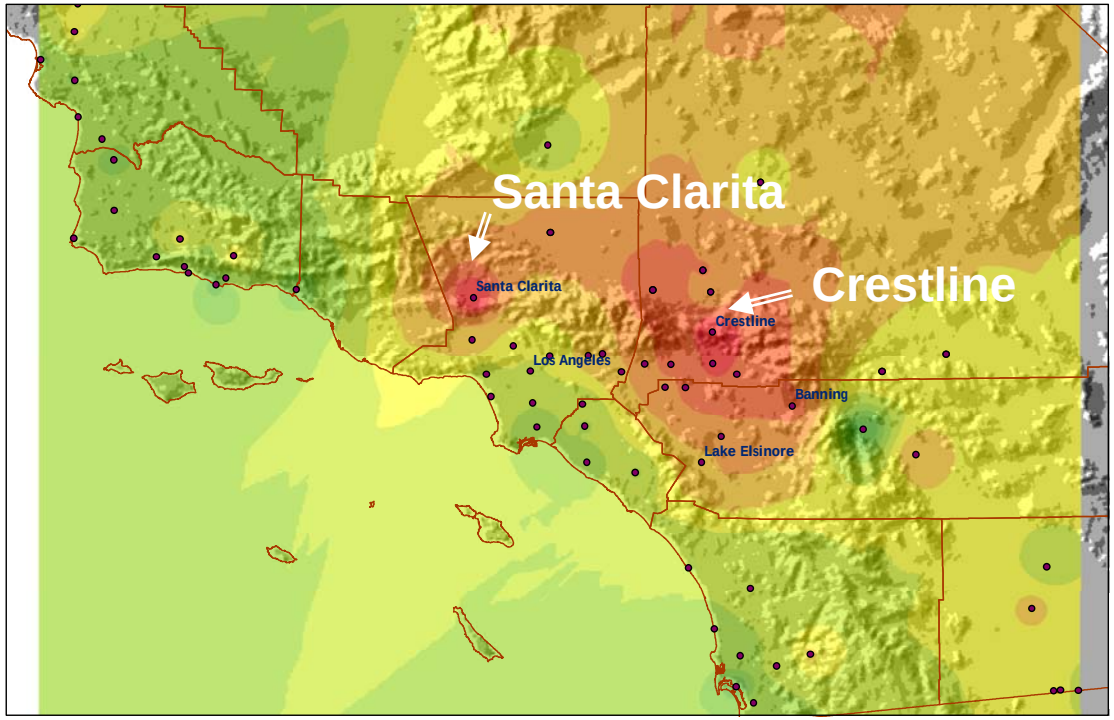
Local Land-Use and Meteorology

- Typical ozone transport patterns result in a double peak as winds bifurcate around terrain
- Measures employed to better replicate observed patterns:
  - > Increasing over water surface drag
  - > altering soil moisture/land usage
  - > alternate mixing schemes
  - > exaggerated wind nudging

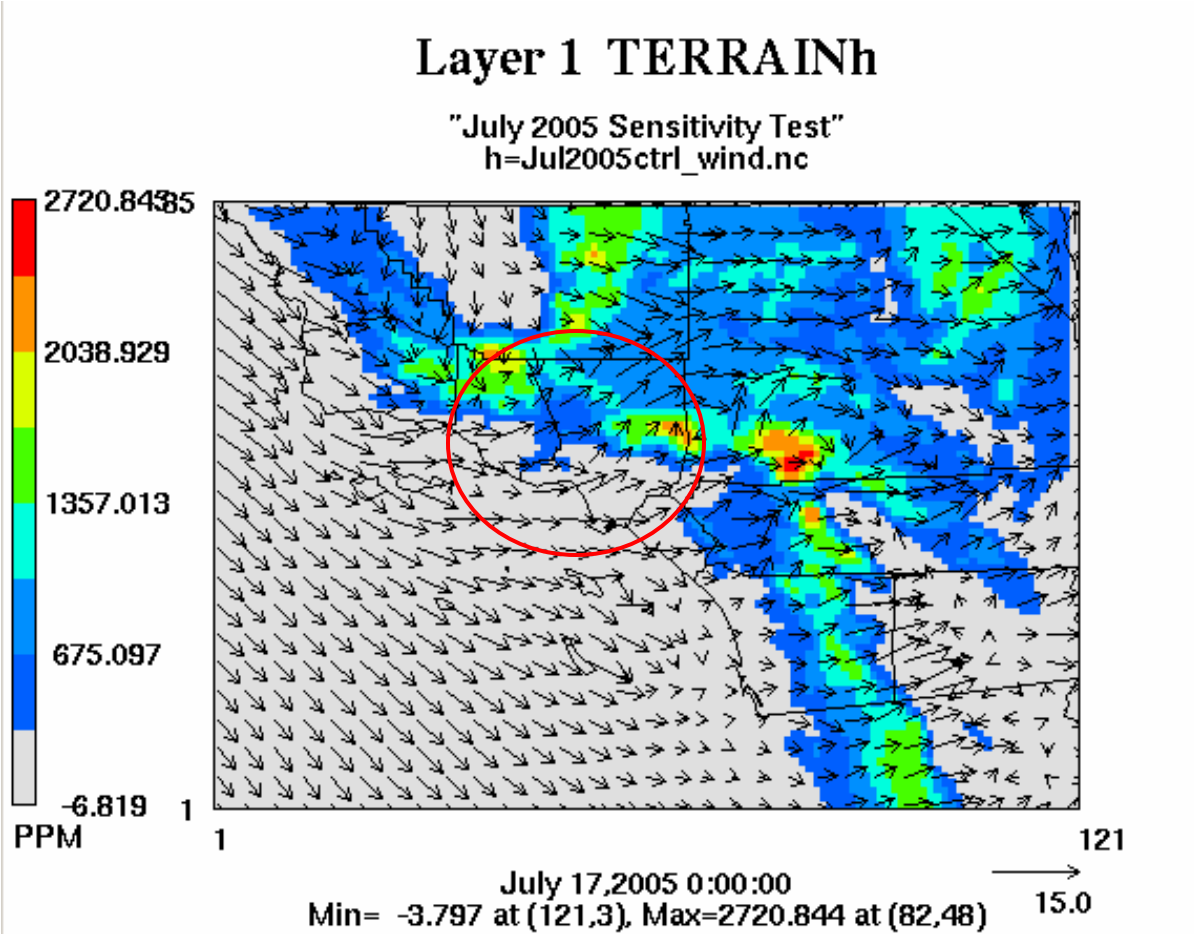
Ozone Double Peak Pattern

Max 1-hr O_3 on July 16th, 2005: 173 ppb at SCLR

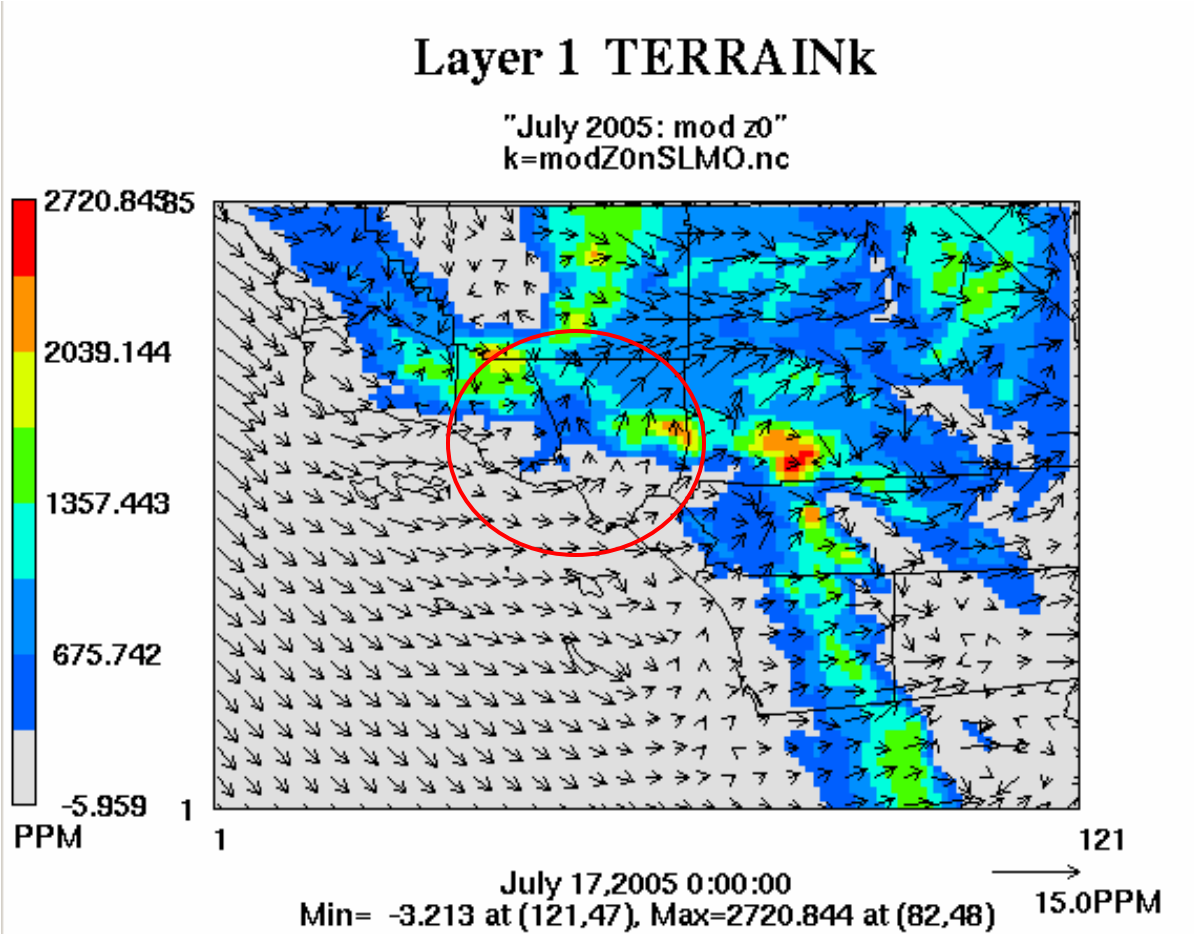
July 16



MM5 Default Run

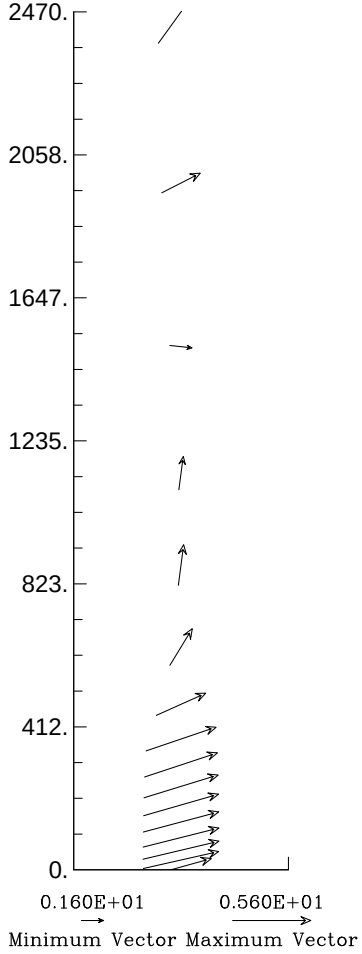


MM5 Modified Run

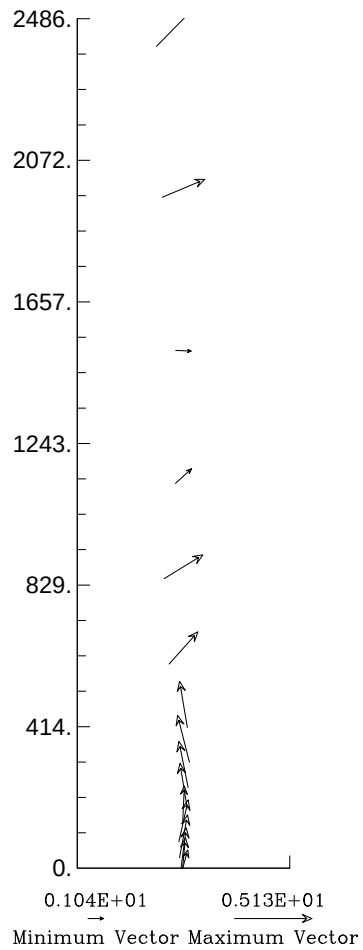


MM5 simulated Wind Profiles:

0000 UTC July 17, 2005



Base



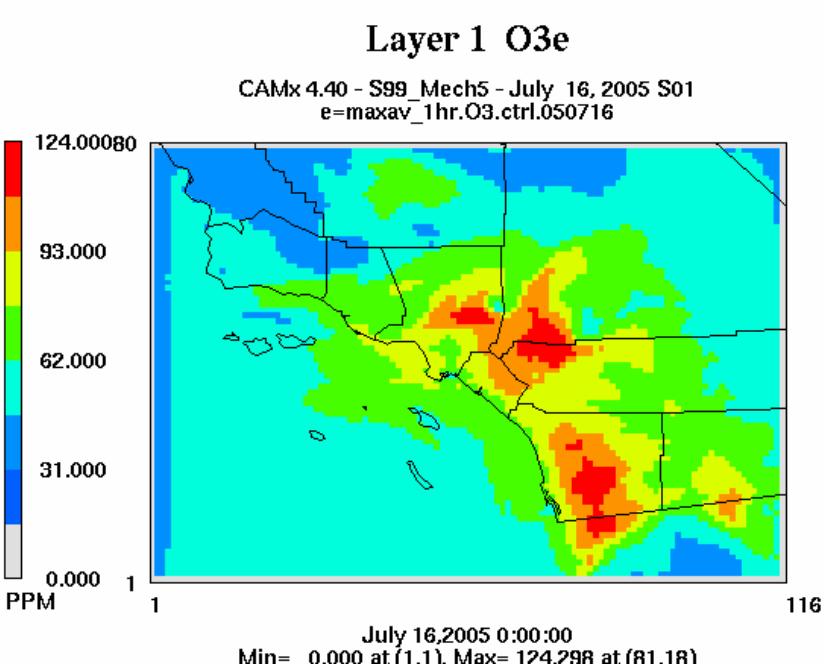
N

4

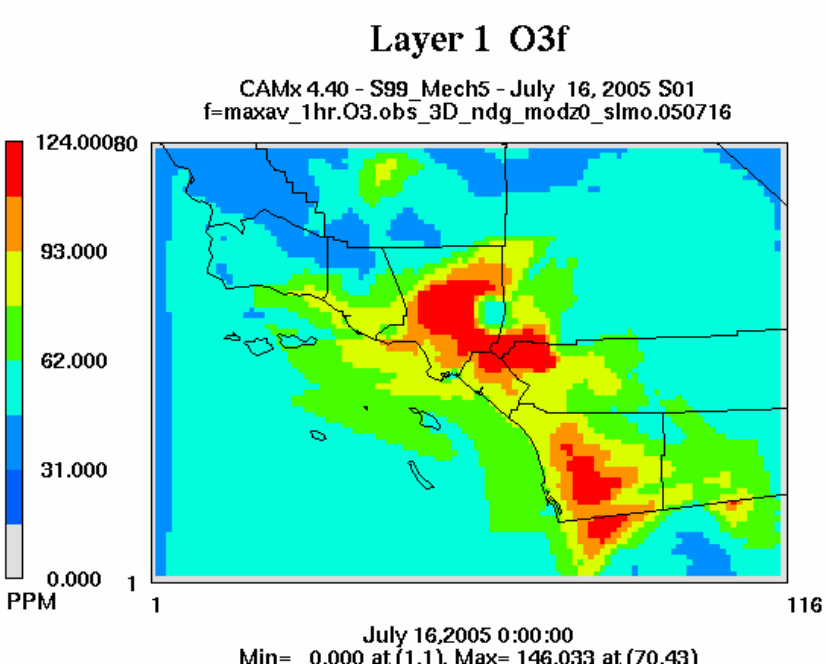
Modified

MM5 Ctrl vs. MM5 Mod: Jul 2005

Control Run



Modified Run



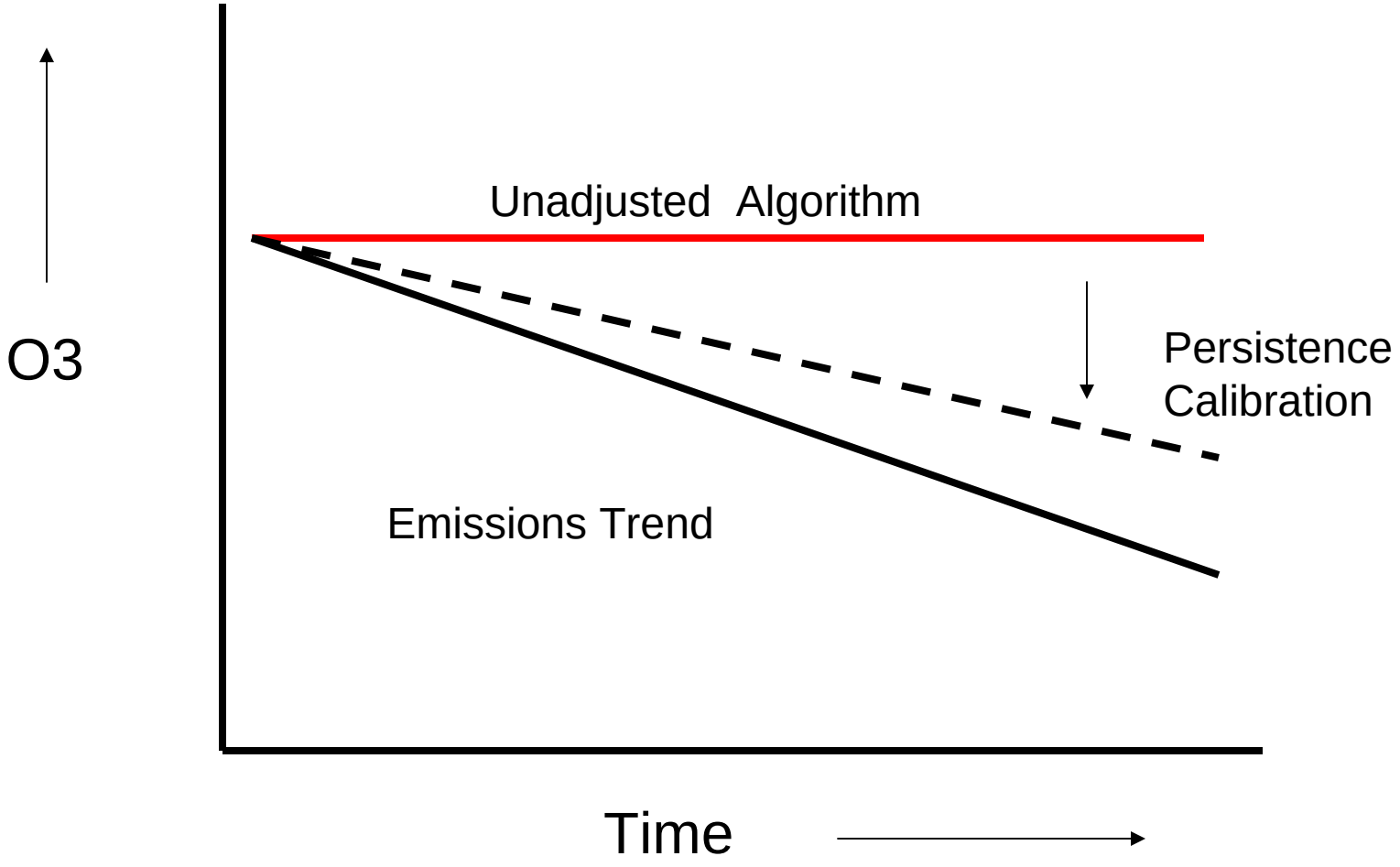
Simulation Evaluation Summary

- The EMC NAM12-CMAQ simulations responded well to daily variations in weather
- Systematic over prediction in area outside the basin were observed
- The 5 vs. 12 km grid selection impacted the peak prediction most
- NOx titration apparent in South Coast Air Basin metropolitan areas

Model Output Statistics

- Numerical output can be used as the basis of the site specific forecast
- Empirically predict maximum 8-hour ozone using model output and yesterday's persistence
- Regression or pattern recognition (neural networks) viable
- Model self-calibrating

Grid to Station Prediction



Recommendation

- Use the model simulations from 2007 to develop preliminary site specific ozone prediction algorithms
- Evaluate PM2.5 forecasts for potential similar application