

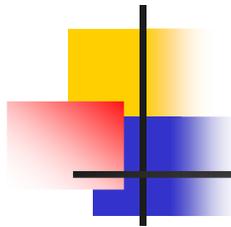
# Comparison of Ambient Measurements to Emissions Representations in Modeling

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Presented by:  
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Sonoma Technology, Inc.  
Petaluma, CA

Presented to:  
The CCOS Technical Committee  
Sacramento, CA  
December 15, 2006





# Project Objective

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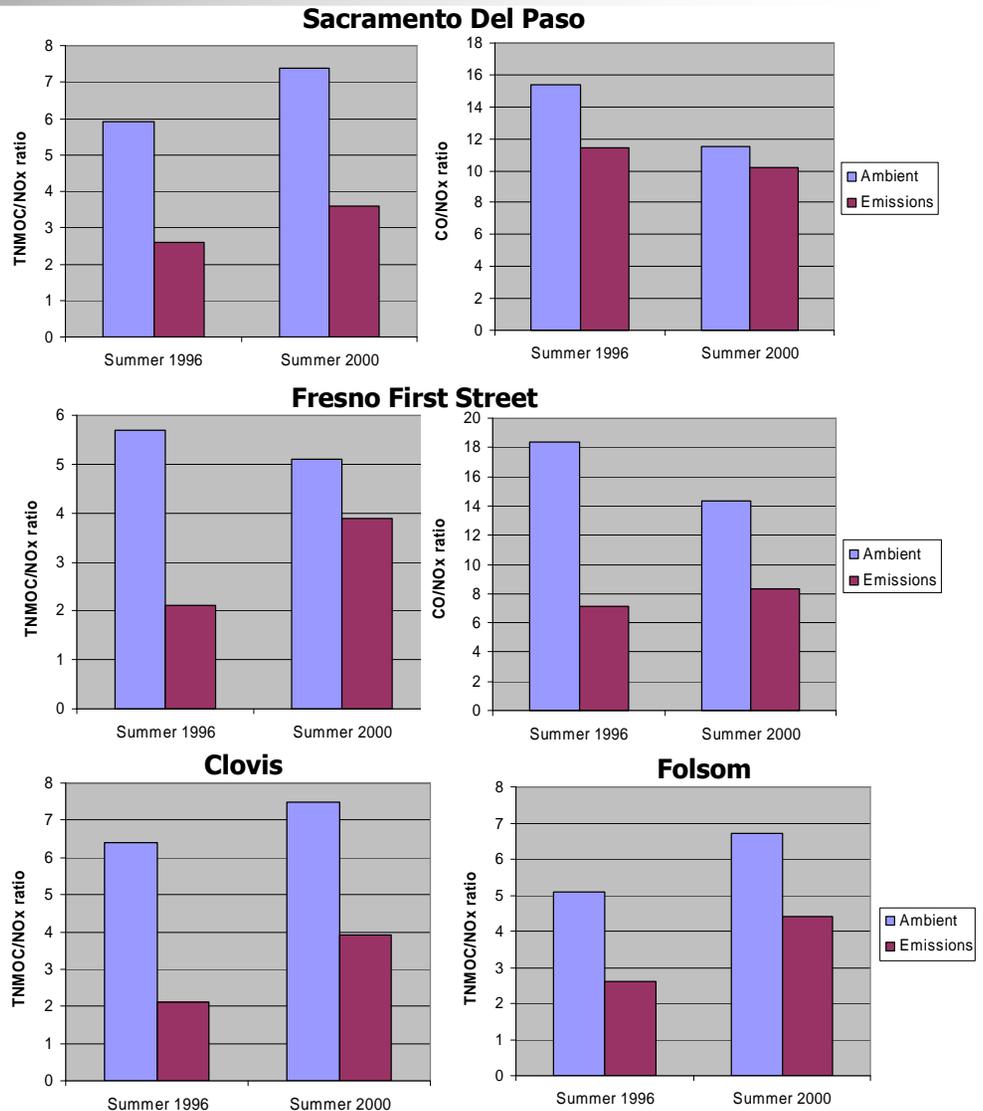
To provide corroborative evidence, with sufficient justification, that can potentially explain disagreements between emission inventory and observed pollutant concentrations.

# Preview of Findings (1 of 3)

- Overall, the emissions data show better agreement with ambient data than previous emission inventories have.

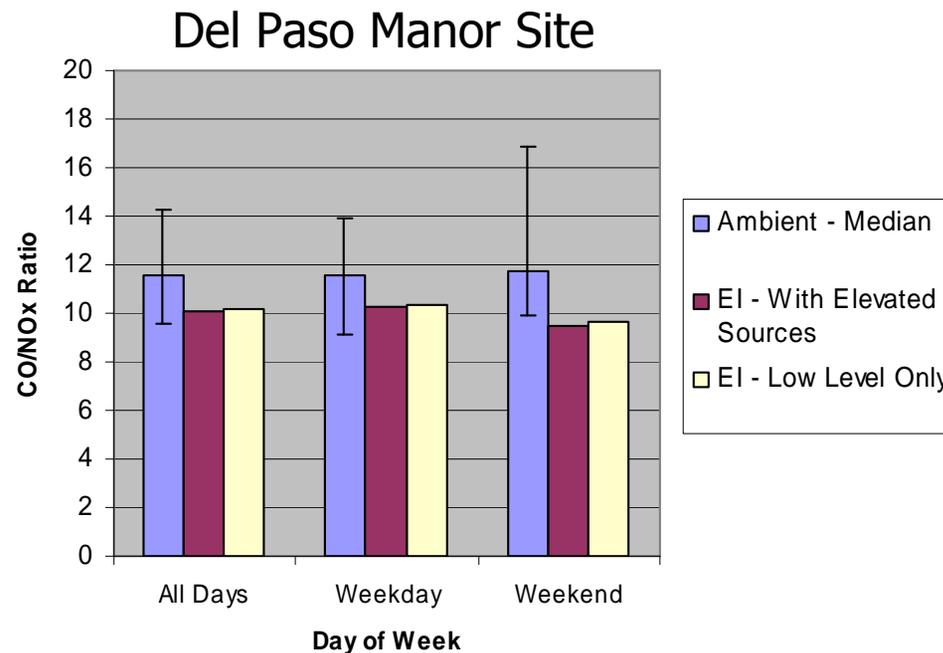
| Air Basin  | Ambient ratio/Emissions ratio |          |          |           |
|------------|-------------------------------|----------|----------|-----------|
|            | DRI 1990                      | DRI 1995 | DRI 2000 | STI 2000* |
| Sacramento | 2.2                           | 1.6      | 1.7      | 1.4 - 2.4 |
| Fresno     | 3.6                           | 2.6      | 1.9      | 1.4 - 7.2 |
| Kern       | --                            | 3.9      | 2.9      | 2.6 - 4.3 |

\*This column shows the range of results from all sites evaluated in each air basin—including both urban and rural sites.

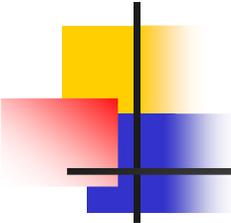


# Preview of Findings (2 of 3)

- At some sites, the emissions data correlate with ambient data as closely as could be expected given analyses limitations\*.



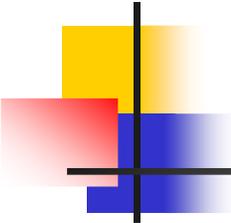
\* "ARB staff believes that an assessment such as this should only be expected to produce ambient/emissions ratios that are within approximately +/- 25 to 50% of 1.0." (ARB, 1997)



## Preview of Findings (3 of 3)

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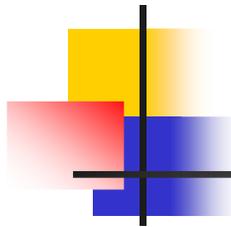
- EI generally under-predicts pollutant ratios
- Urbanized Sacramento area:
  - Good agreement on weekdays
  - Poorer agreement on weekends
- Urbanized Fresno area:
  - Good agreement on weekdays and weekends
- Urbanized Bakersfield area:
  - Poor agreement on weekdays and weekends
- Rural sites don't fully meet underlying assumptions of analysis techniques



# Preview of Recommendations

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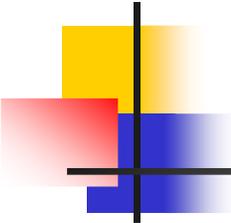
- Improve accuracy of weekend emission estimates.
- Correct spatial distributions of emissions (e.g., from livestock waste and heavy-duty engines).
- Further investigate the poor agreement in Kern County.
- Collect more ambient data at Bay Area sites to enable more robust evaluations.



# Outline

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- Overview of Approach
- Sites Selected
- Results
- Findings and Recommendations
- Questions & Discussion



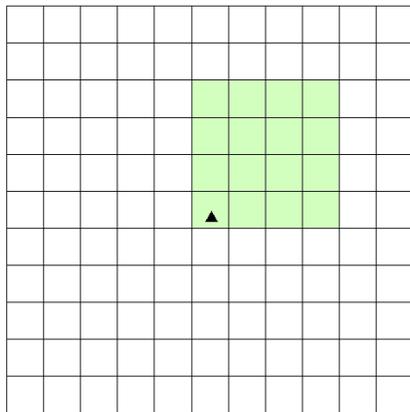
## Overview of Approach (1 of 2)

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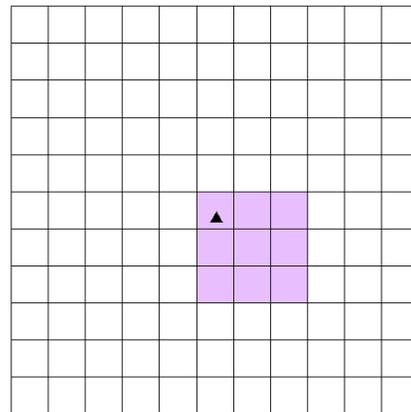
- Comparisons of ambient data to the emission inventory include:
  - TNMOC-to-NO<sub>x</sub> ratios
  - CO-to-NO<sub>x</sub> ratios
  - Ratios of individual species
  - Chemical composition of hydrocarbons

# Overview of Approach (2 of 2)

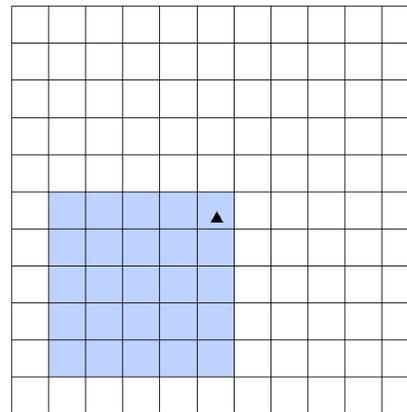
- Spatial and temporal comparisons done by:
  - Weekday vs. weekend
  - Wind quadrants



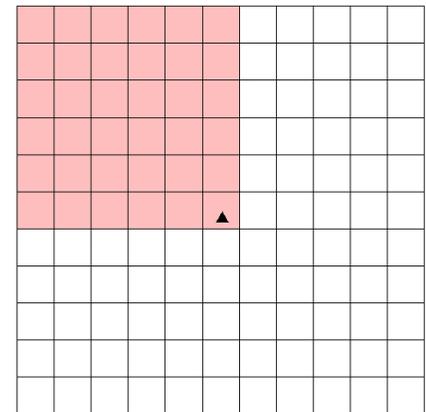
Wind Quadrant 1 (1-90°)



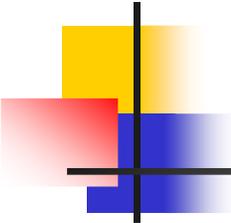
Wind Quadrant 2 (91-180°)



Wind Quadrant 3 (181-270°)



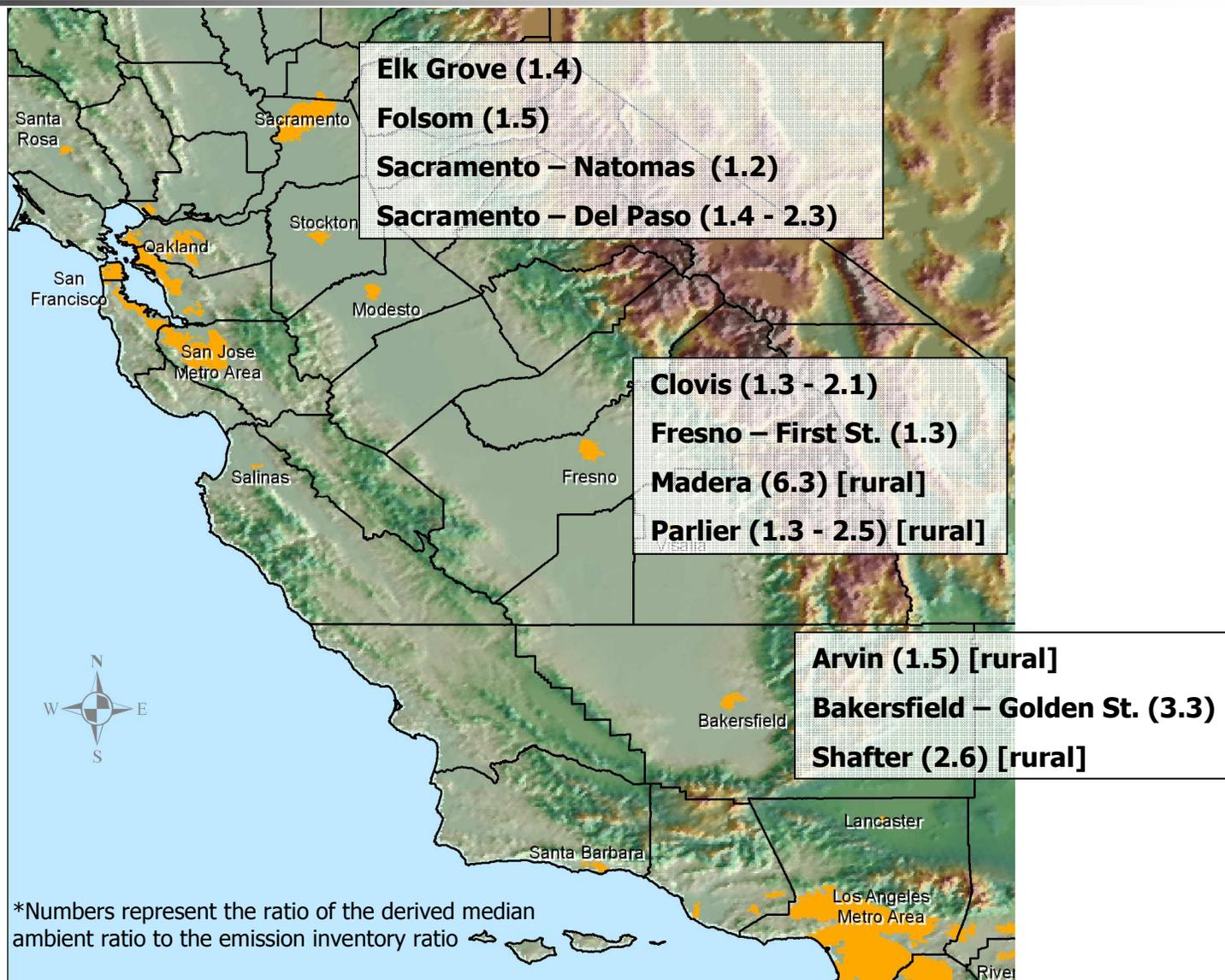
Wind Quadrant 4 (271-360°)



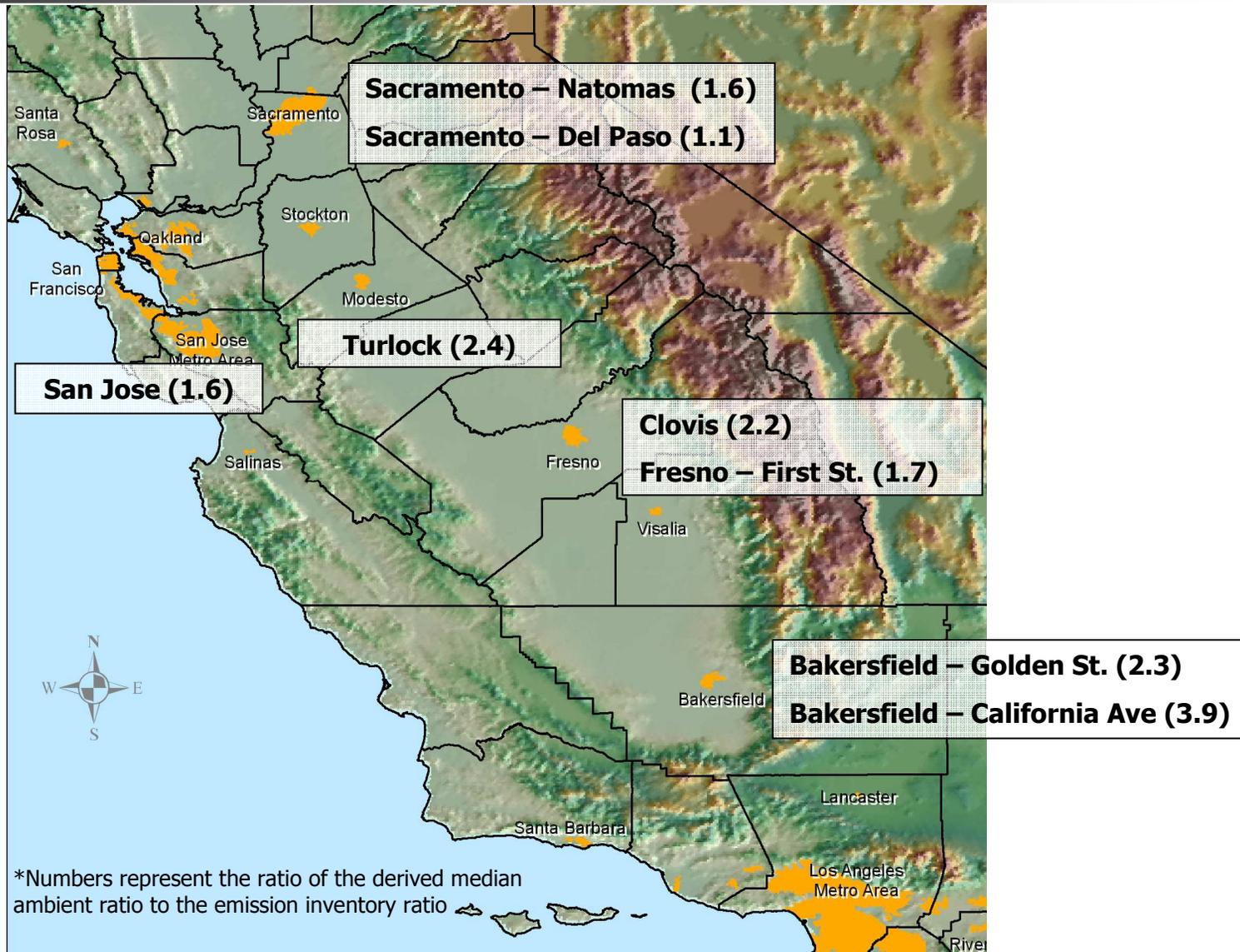
# Monitoring Sites Selected

| Site | Tier | District | Site Name                           | TNMOC/NOx | CO/NOx | Species ratios | VOC fingerprints |
|------|------|----------|-------------------------------------|-----------|--------|----------------|------------------|
| BGS  | 1    | SJV      | Bakersfield Stn. (Golden State)     | X         | X      | X              | X                |
| CLO  | 1    | SJV      | Clovis Stn.                         | X         | X      | X              | X                |
| FSF  | 1    | SJV      | Fresno Stn. (First St.)             | X         | X      |                |                  |
| NAT  | 1    | Sacto    | Sacramento/Natomas Stn.             | X         | X      | X              | X                |
| SDP  | 1    | Sacto    | Sacramento Stn. (Del Paso Manor)    | X         |        | X              | X                |
| SUN  | 1    | Bay Area | Sunol Stn.                          |           |        | X              |                  |
| FLN  | 2    | Sacto    | Folsom Stn.                         | X         |        | X              | X                |
| PLR  | 2    | SJV      | Parlier Stn.                        | X         |        | X              | X                |
| ARV  | 3    | SJV      | Arvin Stn.                          | X         | X      | X              | X                |
| ELK  | 3    | Sacto    | Elk Grove Stn.                      | X         |        |                | X                |
| M29  | 3    | SJV      | Madera Stn.                         | X         |        | X              | X                |
| SHA  | 3    | SJV      | Shafter Stn.                        | X         |        | X              | X                |
| SJ4  | 3    | Bay Area | San Jose Stn. (4 <sup>th</sup> St.) |           | X      |                |                  |
| TSM  | 3    | SJV      | Turlock Stn.                        |           | X      |                |                  |
| BAC  | 4    | SJV      | Bakersfield Stn. (California Ave.)  |           | X      |                |                  |
| GNBY | 4    | Sacto    | Granite Bay Stn.                    |           |        | X              |                  |

# Comparison of TNMOC/NOx Ratios



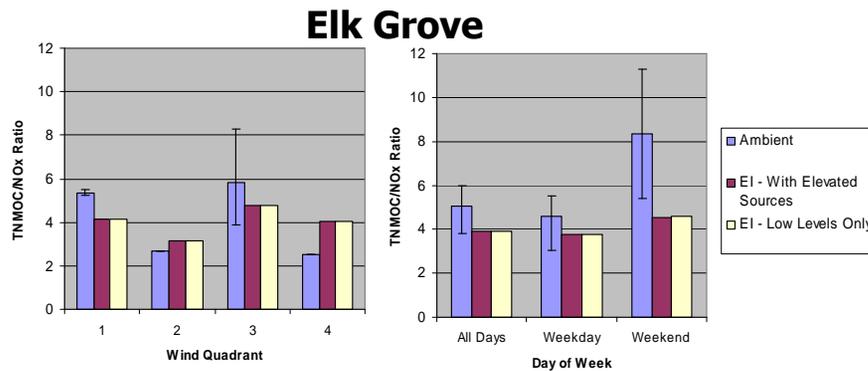
# Comparison of CO/NOx Ratios



# Sacramento Area (1 of 3)

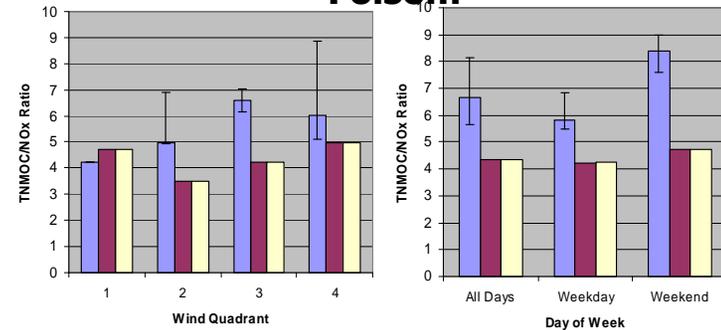
## TNMOC/NO<sub>x</sub>

- Better agreement on weekdays
- Note poor agreement in wind quadrant 3 at Del Paso Manor

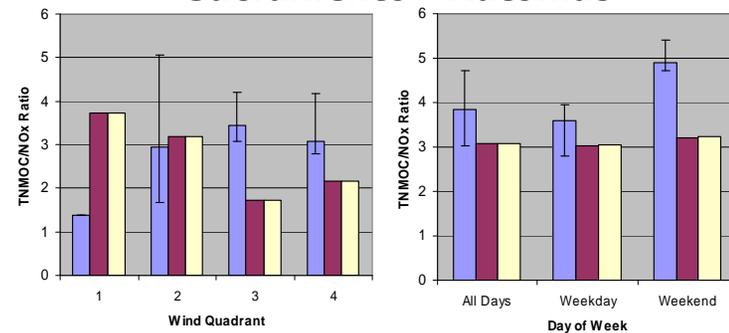


Error bars represent 25th and 75th percentiles

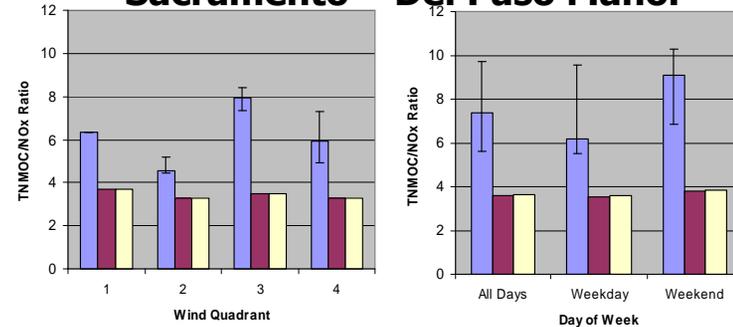
### Folsom



### Sacramento - Natomas



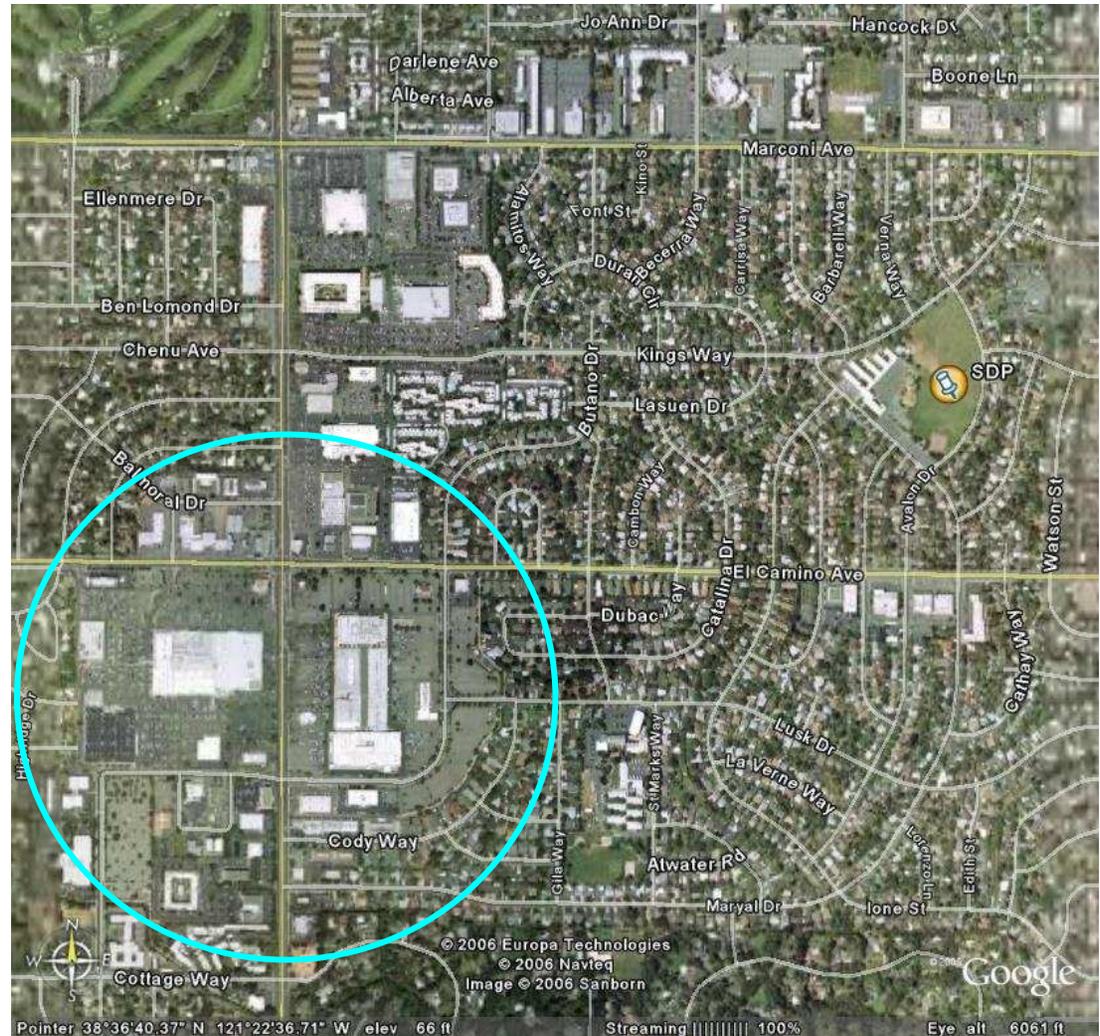
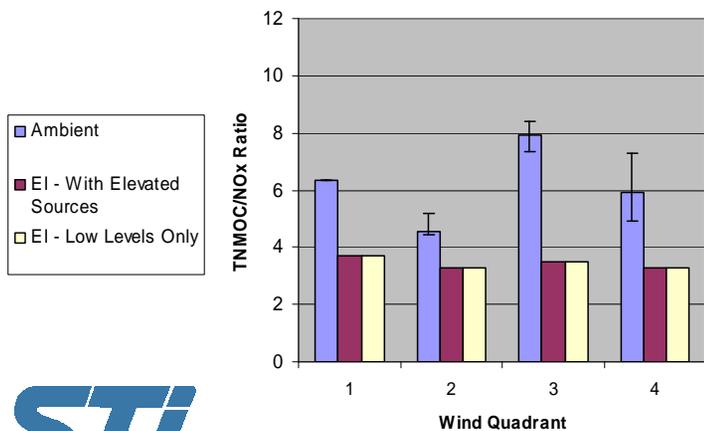
### Sacramento - Del Paso Manor



# Sacramento (2 of 3)

## Del Paso Manor

- **Poorest agreement in wind quadrant 3**
- **Shopping center 1km southwest of site**
- **Possible issue capturing hot soak emissions in inventory**

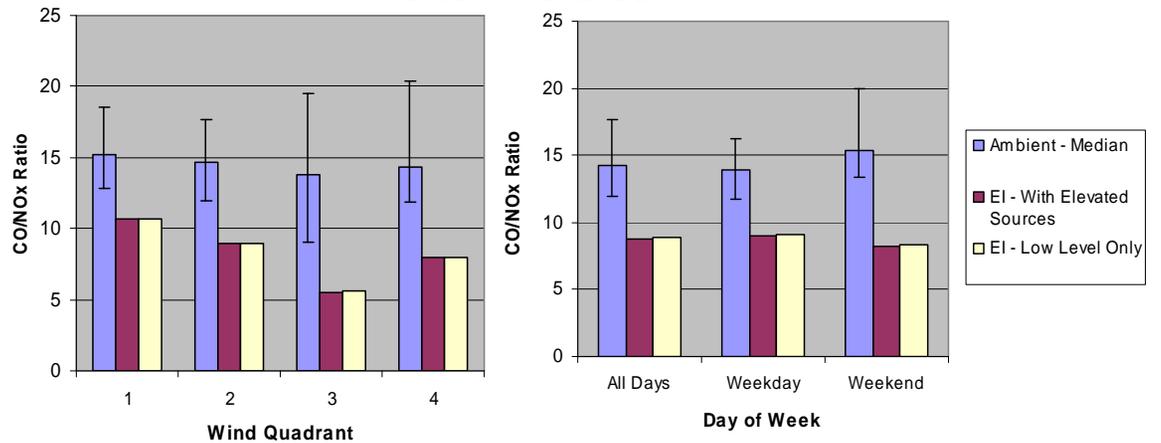


# Sacramento Area (3 of 3)

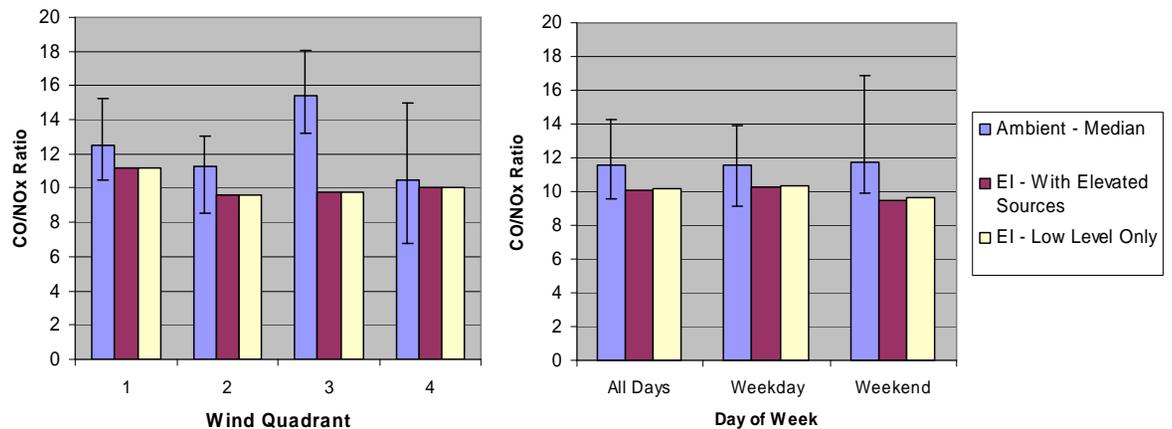
## CO/NO<sub>x</sub>

- Weekdays and weekends are similar
- Agricultural or heavy duty sources appear to be misrepresented (too high) in Natomas quadrant 3
- Del Paso ratios agree well

Natomas Site



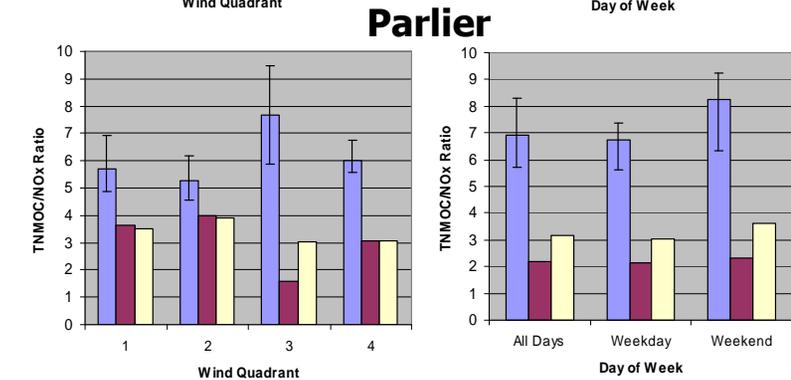
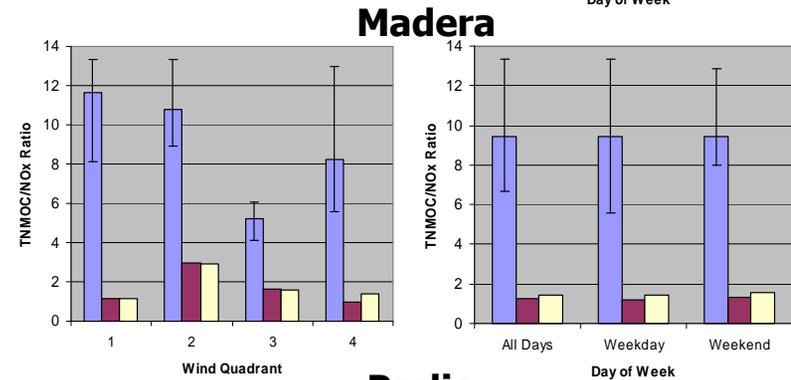
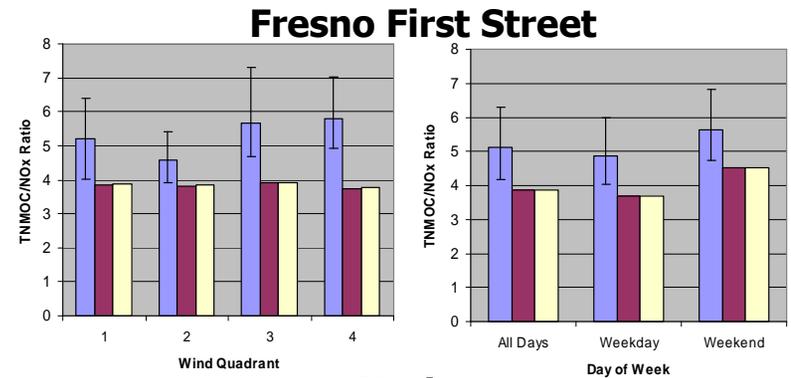
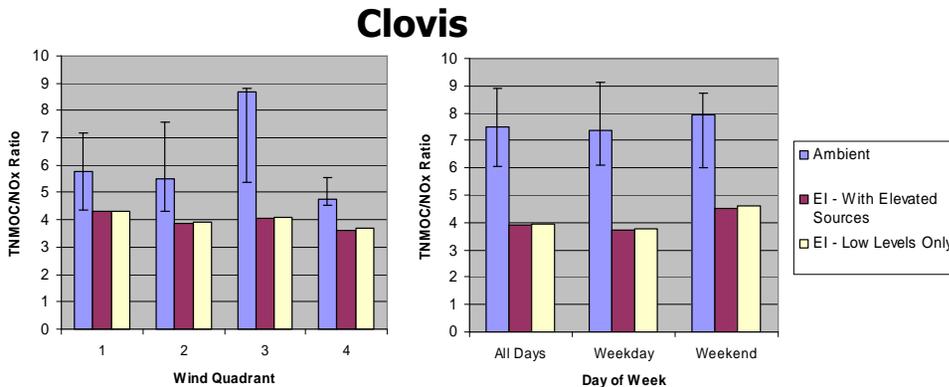
Del Paso Manor Site



# Fresno Area (1 of 3)

## TNMOC/NO<sub>x</sub>

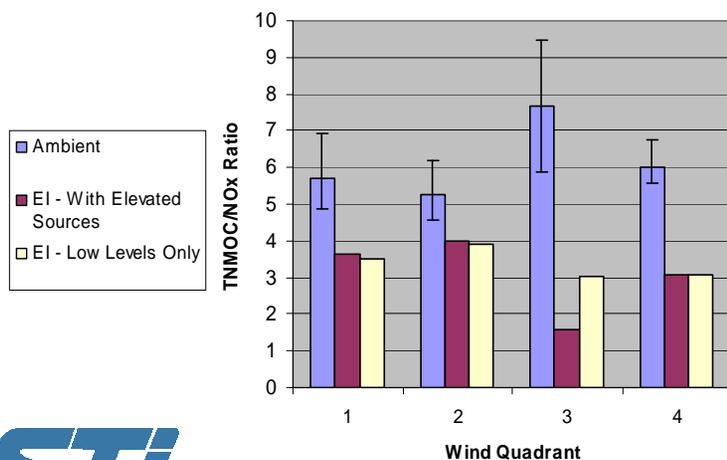
- Weekdays and weekends are similar
- Changes in real world growth between Clovis and Fresno compared to surrogates (CLO-quadrant 3)
- Rural Madera site with low emission density (doesn't fully meet assumptions)



# Fresno Area (2 of 3)

## Parlier TNMOC/NOx

- **Agrees well except in quadrant 3**
- **Winery in quadrant 3 is not identified as a point source in the inventory**

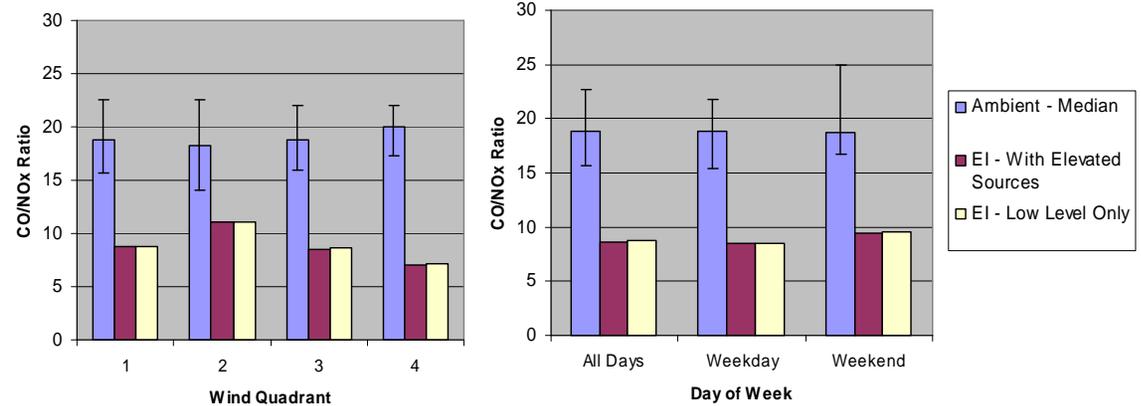


# Fresno Area (3 of 3)

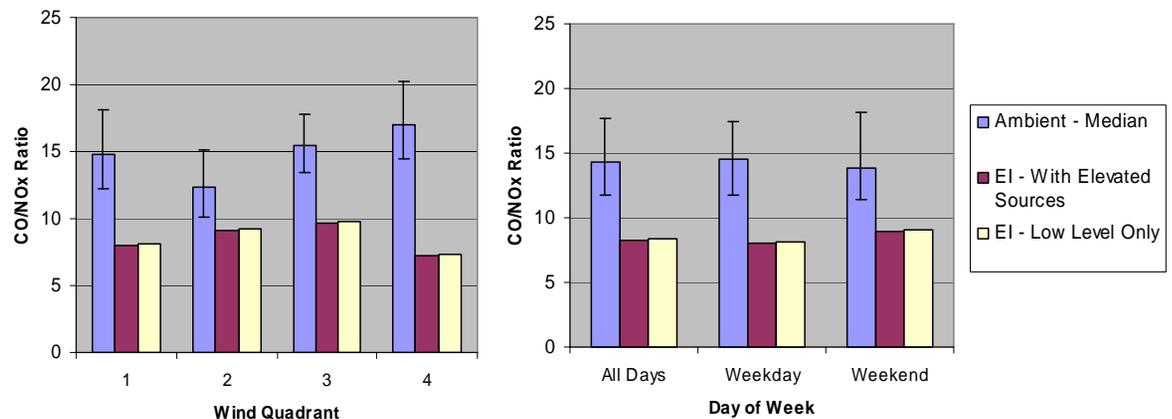
## CO/NOx

- **Similar agreement on weekdays and weekend days**
- **Agreements not as good as in the Sacramento area**
- **May suggest overestimated heavy-duty NOx emissions in the area**

### Clovis



### Fresno First Street

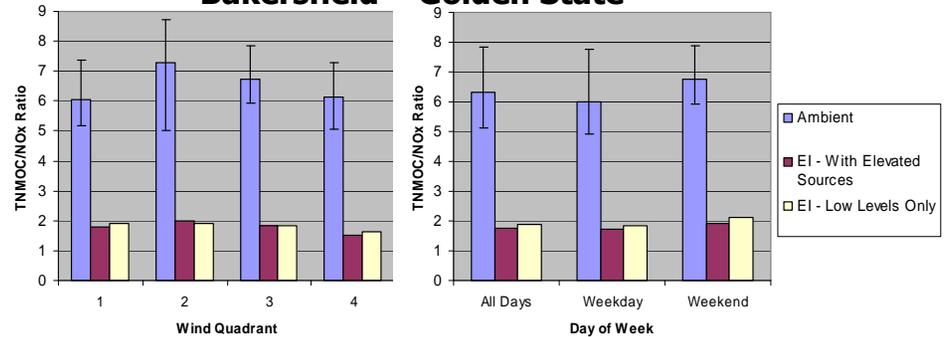


# Kern County (1 of 2)

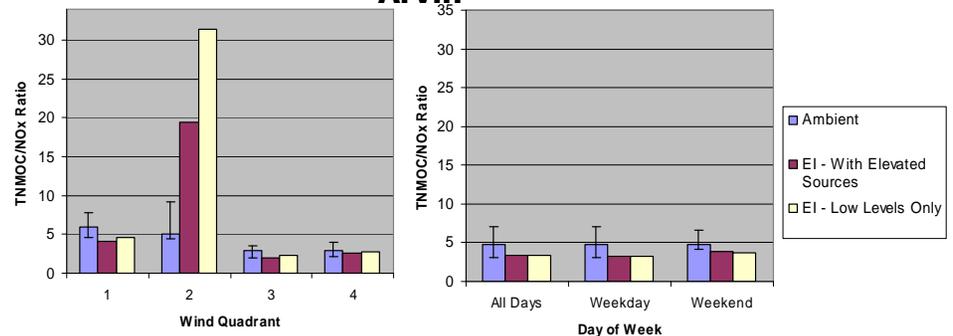
## TNMOC/NO<sub>x</sub>

- **Ambient ratios are 2 to 4 times higher than emissions ratio (Much worse than Sacramento/Fresno)**
- **Agreement does not vary between weekdays and weekends**
- **TNMOC emissions in quadrant 2 of Arvin are dominated by biogenics**

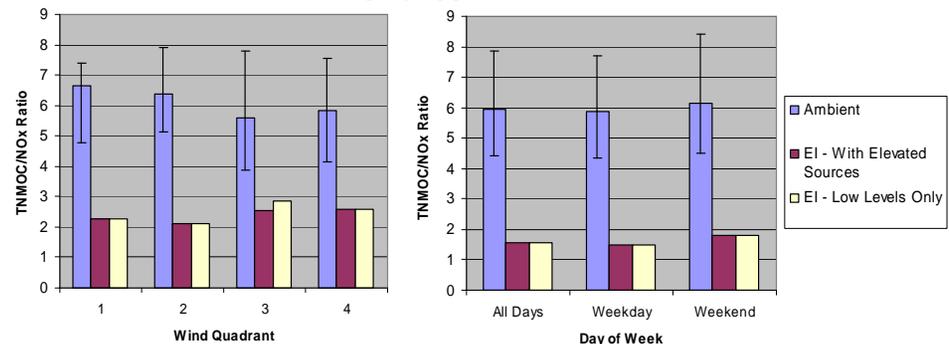
**Bakersfield – Golden State**



**Arvin**



**Shafter**

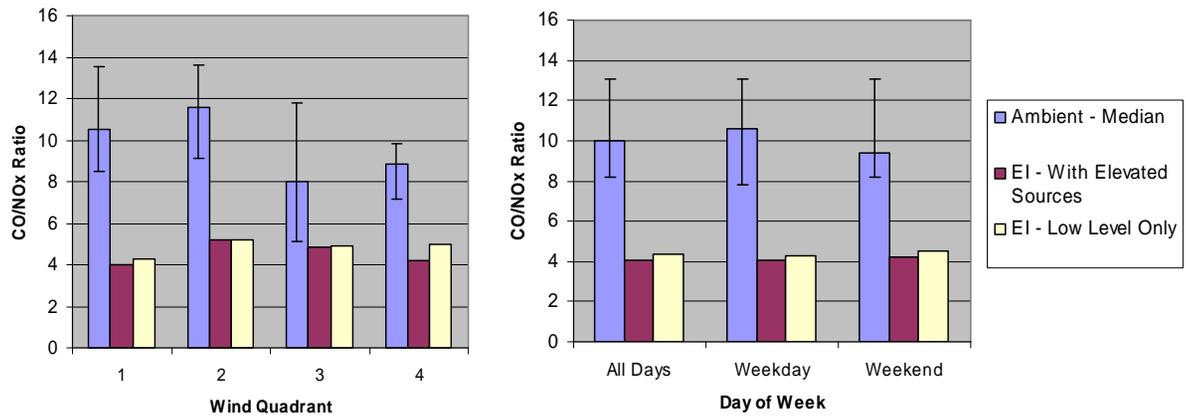


# Kern County (2 of 2)

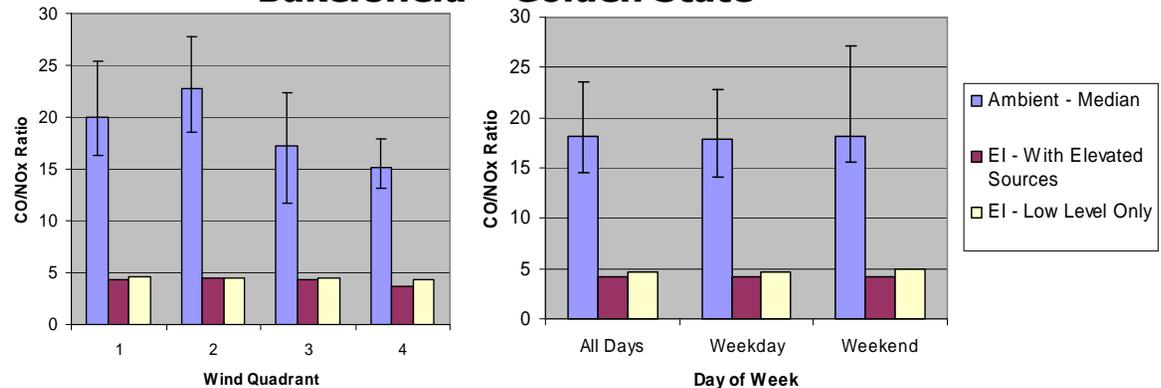
## CO/NOx

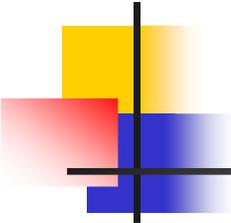
- At Calif. Ave., best agreement in wind quadrants 3 and 4
- Poor overall agreement at the Golden State site

**Bakersfield – California Ave.**



**Bakersfield – Golden State**

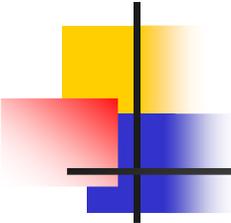




# Individual Species Ratios

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- Compared amounts of individual hydrocarbons in the ambient data and emission inventory
  - Acetylene/benzene
  - Acetylene/propylene
  - Benzene/m- and p-xylene
  - Benzene/o-xylene
  - Benzene/toluene
  - Toluene/m- and p-xylene
  - Toluene/o-xylene
- Emission ratios generally show good agreement with ambient ratios

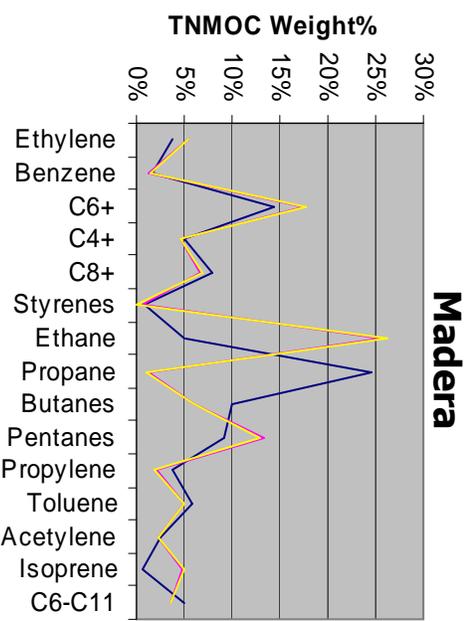
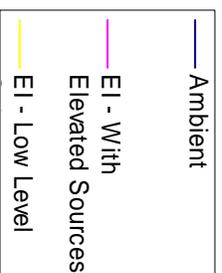
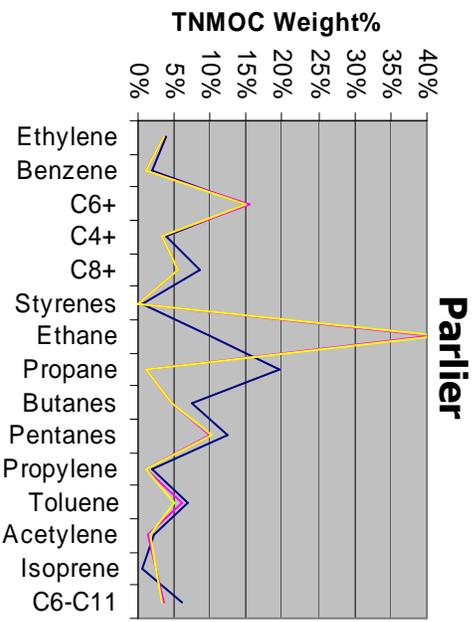
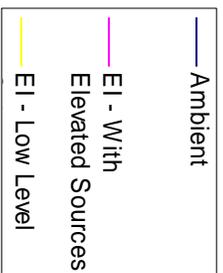
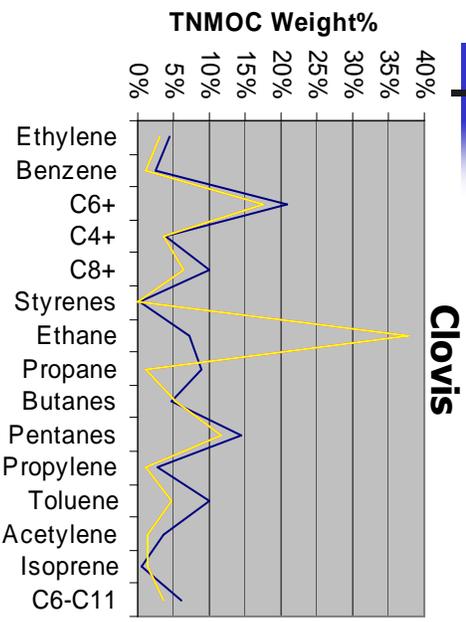


# Fingerprint Comparisons (1 of 5)

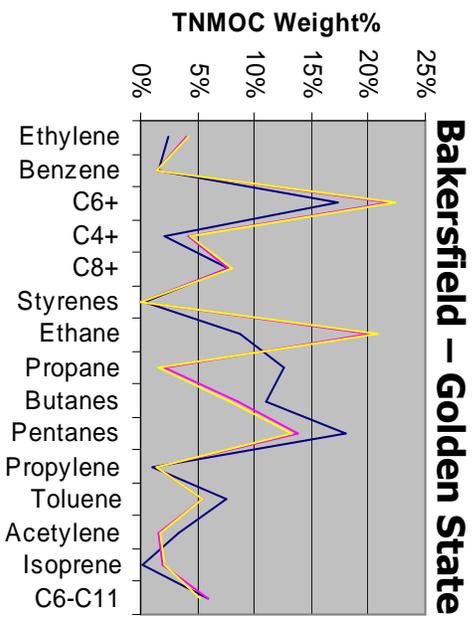
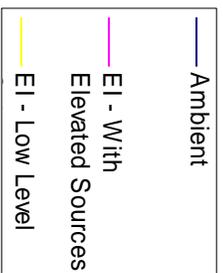
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- Comparisons were performed for 10 sites
- Analyses showed:
  - Speciation of emission inventory is generally representative of the TNMOC composition detected by ambient monitoring sites
  - Ethane is consistently higher in the emission inventory
  - Propane is consistently lower in the emission inventory
  - Isoprene is consistently higher in the emission inventory

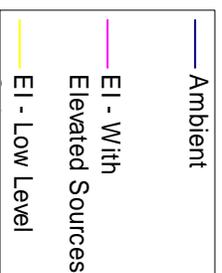
# Fingerprint Comparisons (2 of 5)



**Madera**



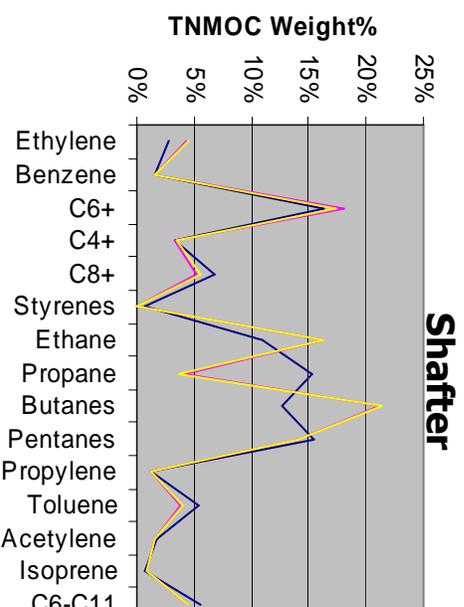
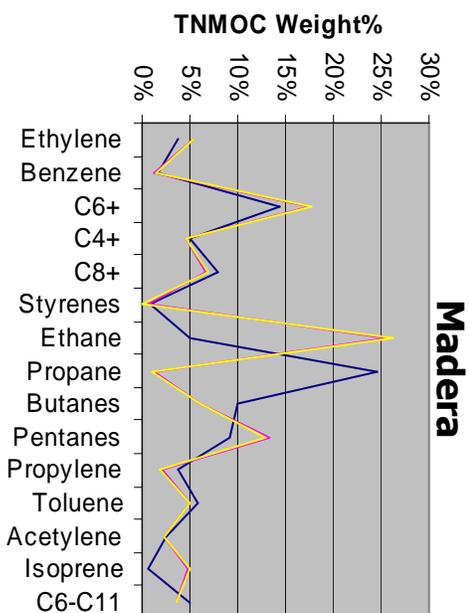
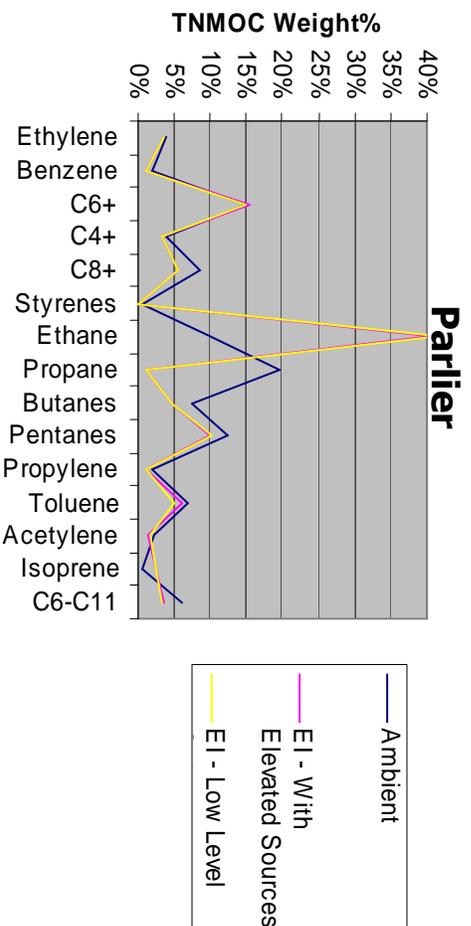
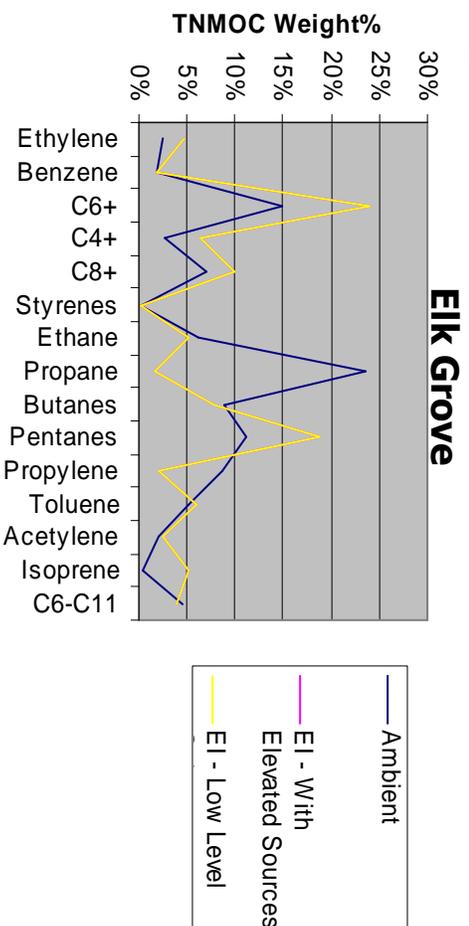
**Bakersfield - Golden State**



Ethane: livestock emissions spatially allocated using population density.



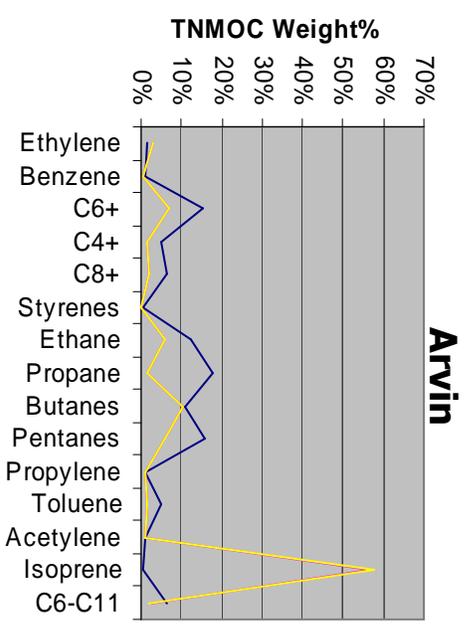
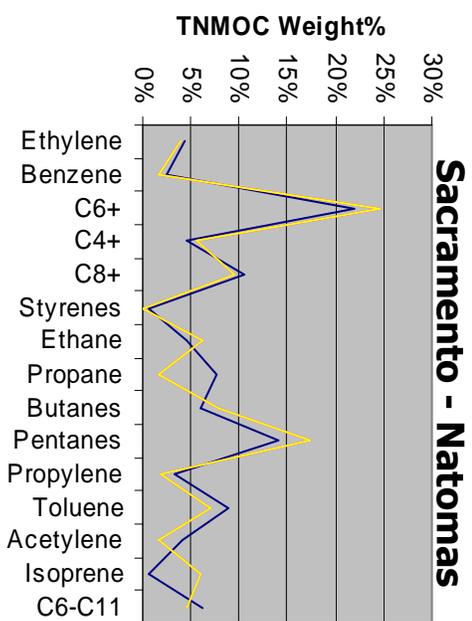
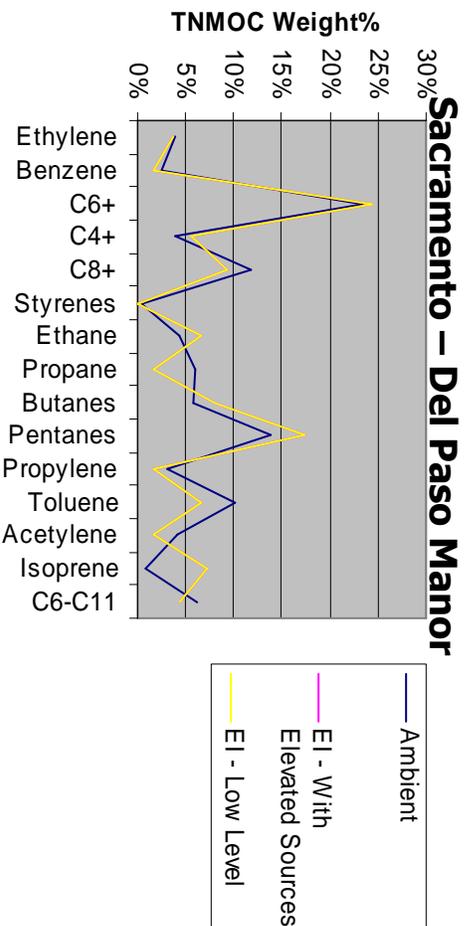
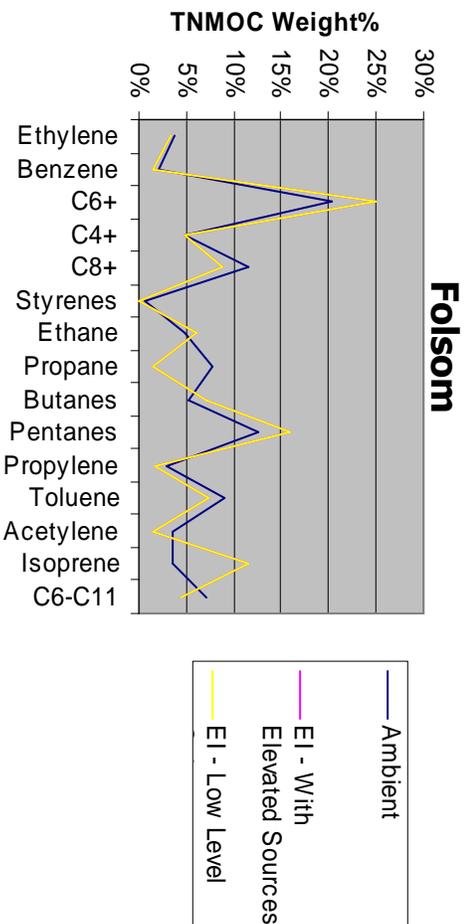
# Fingerprint Comparisons (3 of 5)



Generally Propane is associated with oil and gas extraction, except for major distribution center located at Elk Grove.



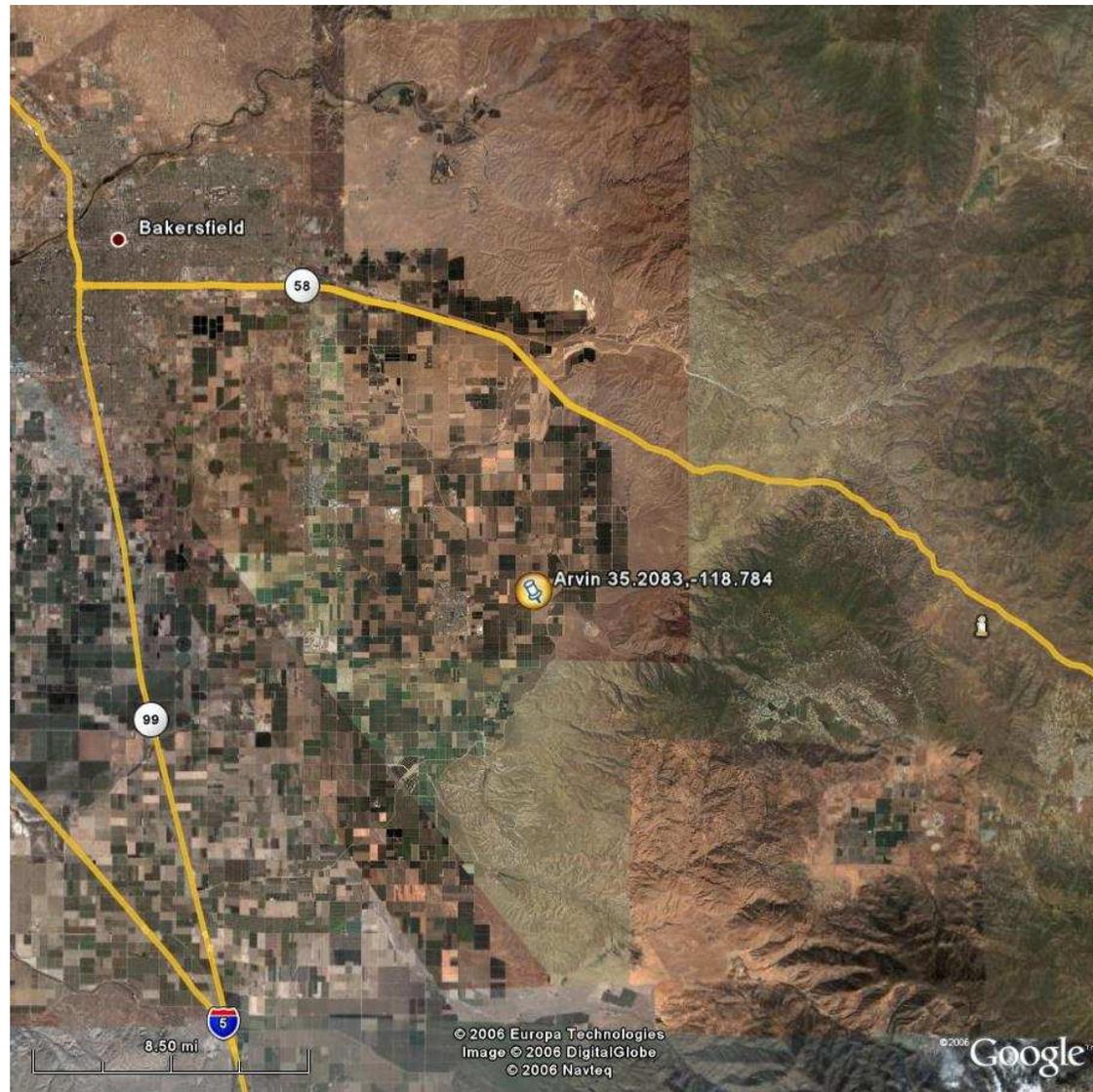
# Fingerprint Comparisons (4 of 5)

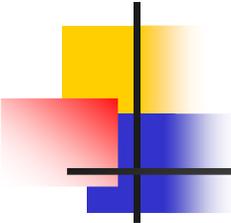


Isoprene: reactivity issues; possible overestimated biogenics at Arvin.



# Fingerprint Comparisons (5 of 5)

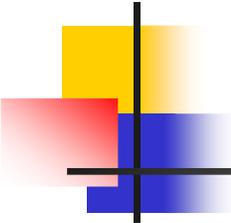




# Overall Findings

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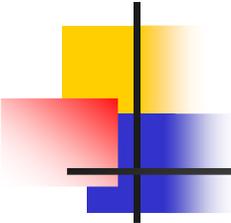
- Overall, the emissions data show better agreement with ambient data than previous emission inventories have.
- At some sites, the emissions data correlate with ambient data as closely as could be expected given analyses limitations.
- EI generally under-predicts pollutant ratios



# Overall Findings

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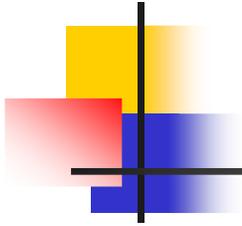
- **Urbanized Sacramento area:**
  - Good agreement on weekdays
  - Poorer agreement on weekends
- **Urbanized Fresno area:**
  - Good agreement on weekdays and weekends
- **Urbanized Bakersfield:**
  - Poor agreement on weekdays and weekends



# Recommendations

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- Improve accuracy of weekend emission estimates.
- Correct spatial distribution of emissions (e.g., from livestock waste, and heavy duty engines).
- Further investigate the poor agreement in Kern County.
- Collect more ambient data at Bay Area sites to enable more robust evaluations.



# Questions and Discussion