

# **Weekend/Weekday Ozone Study in the South Coast Air Basin**

Eric Fujita, William Stockwell, David Campbell, Robert Keislar  
John Sagebiel, Wendy Goliff, and Barbara Zielinska

Desert Research Institute

Reno, Nevada

Douglas Lawson

National Renewable Energy Laboratory

Golden, Colorado

8<sup>th</sup> Diesel Engine Emissions Reduction Conference

San Diego, CA

August 25-29, 2002

# Acknowledgments

## Sponsors

- This work was funded by the U.S. Department of Energy, Office of Heavy Vehicle Technologies (Drs. James Eberhardt and Michael Gurevich, Program Managers) through National Renewable Energy Laboratory
- Additional funding was provided by the Coordinating Research Council for VOC source apportionment

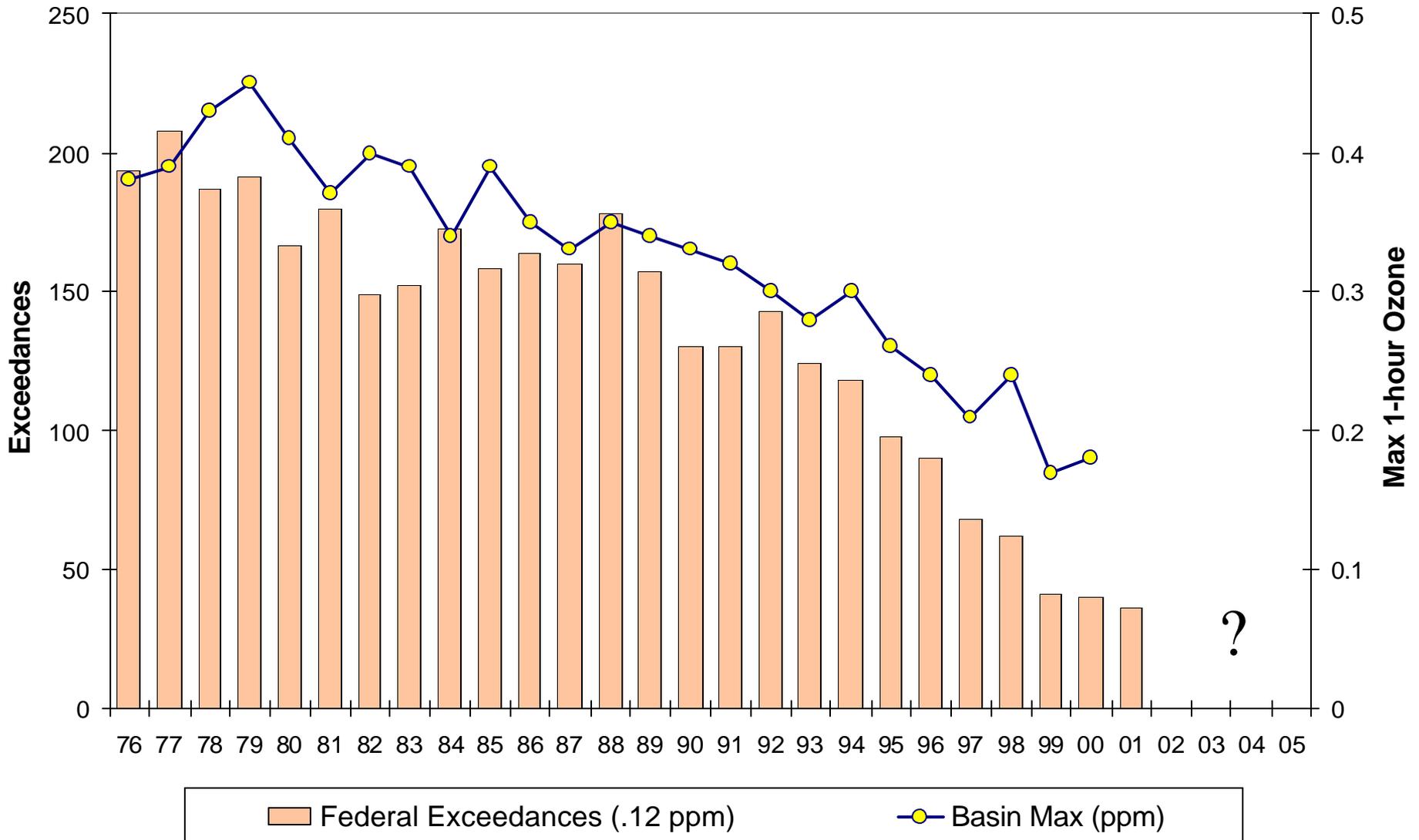
## Technical and Logistical Assistance

- South Coast Air Quality Management District
- California Air Resources Board
- Bay Area Air Quality Management District

# Overview of Presentation

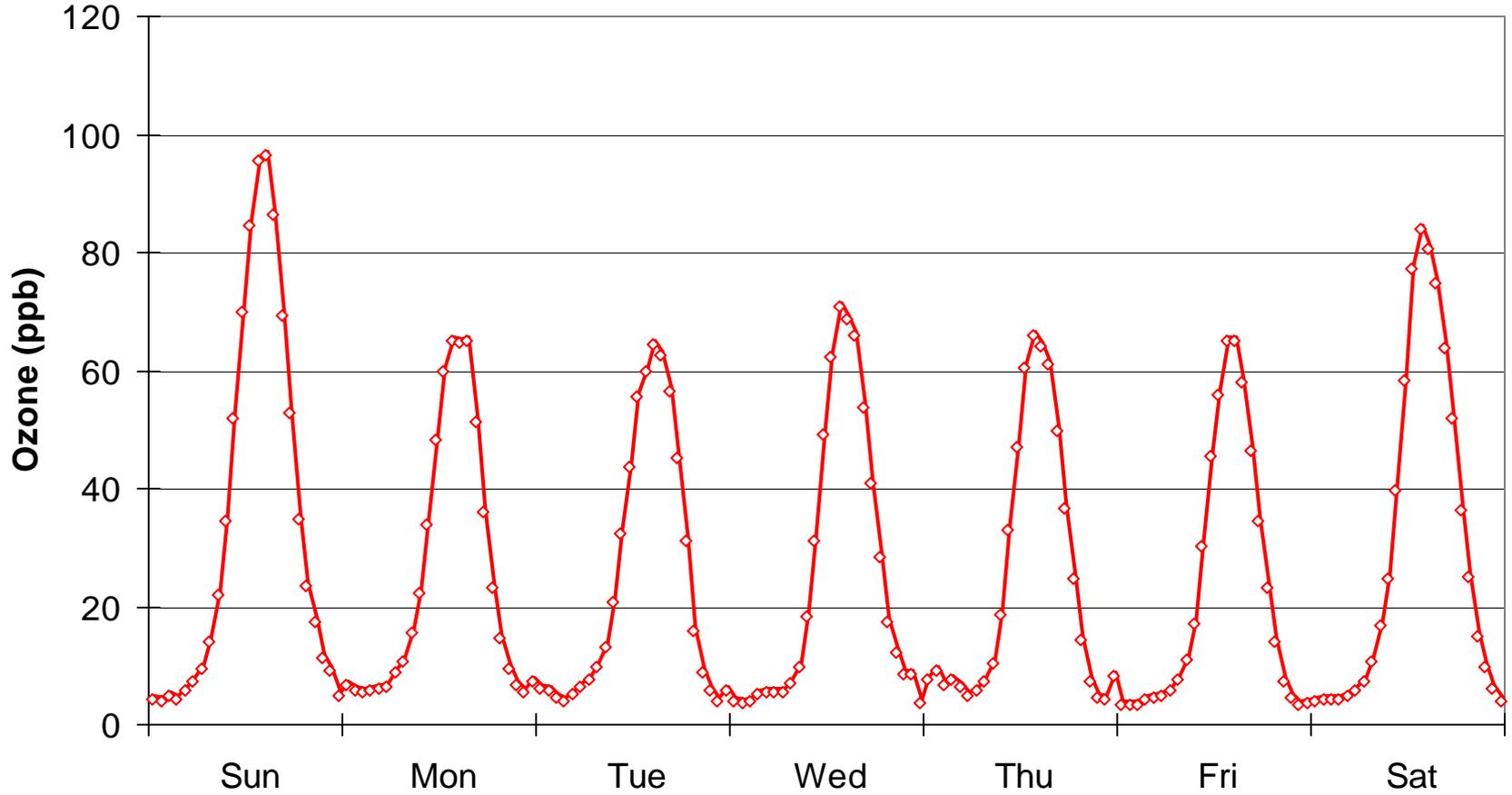
- Trends of Ozone and Precursor (VOC and NO<sub>x</sub>) Concentrations in the South Coast Air Basin (SoCAB)
- Day-of-Week Variations in Ozone and Precursor Concentrations
- Factors that explain the trends in the weekend/weekday differences in ozone
  - 1) inhibition of ozone formation by NO
  - 2) rate of ozone formation
- Source Apportionment of Ozone Precursors, NO<sub>x</sub> and Hydrocarbons
- Photochemical Box Model Results

# Trends in Maximum 1-hour Ozone and Number of Annual Exceedances of the Federal 1-hour Ozone Standard in the SoCAB from 1976 to 2001



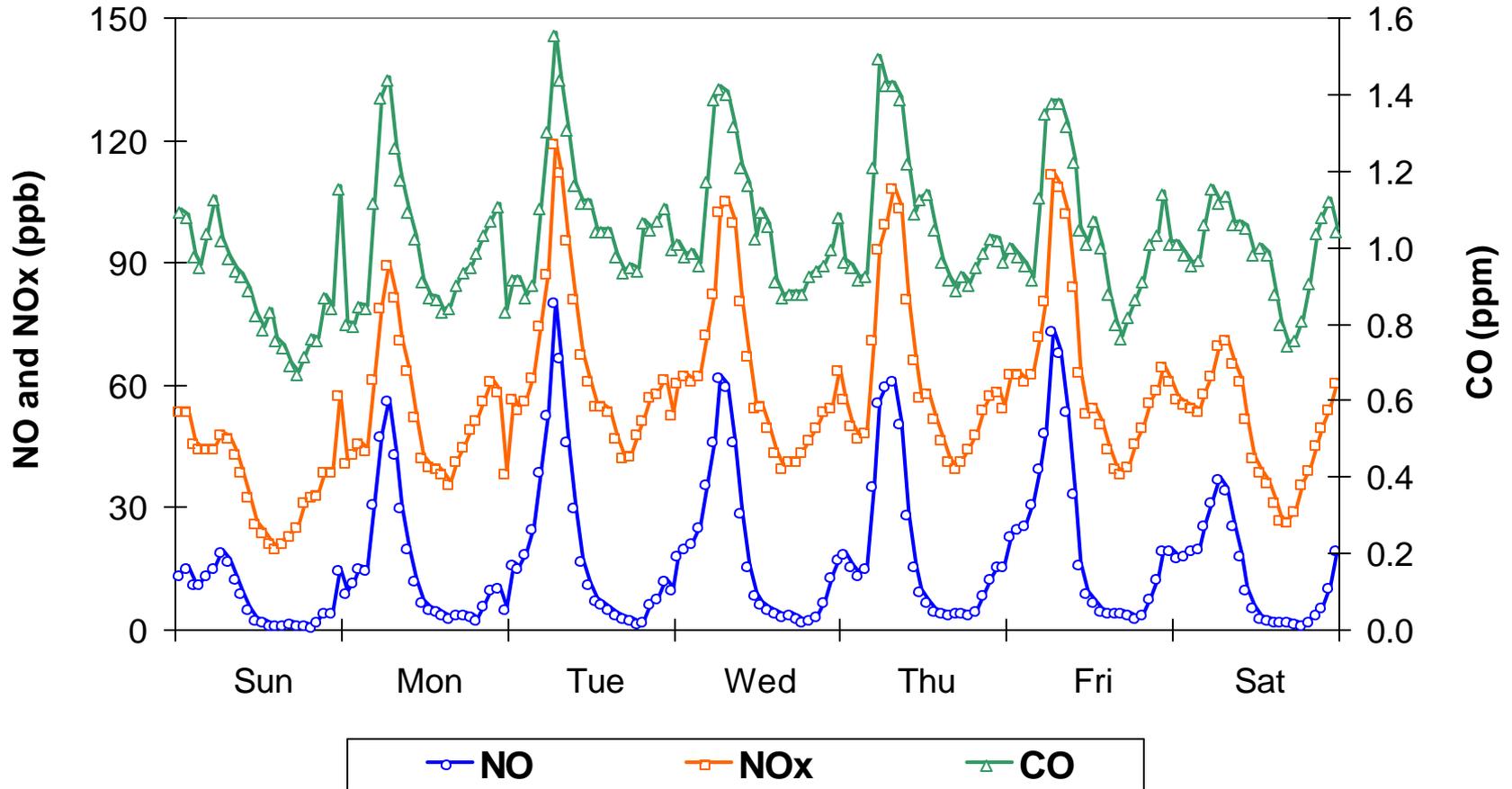
# Mean Weekly Variations in Ozone

Azusa, Summer 2000



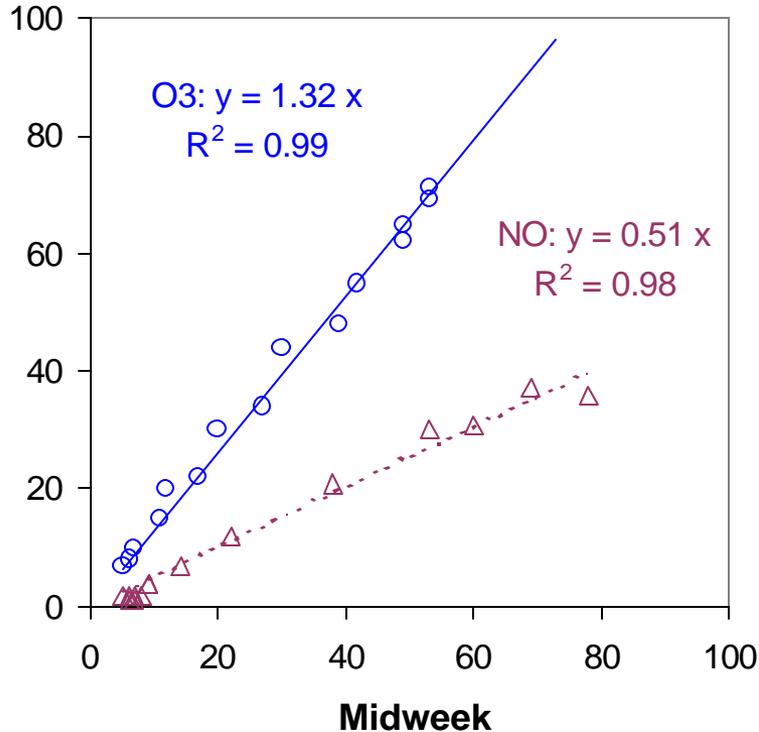
# Mean Weekly Variations in NO, NOx and CO

## Azusa, Summer 2000

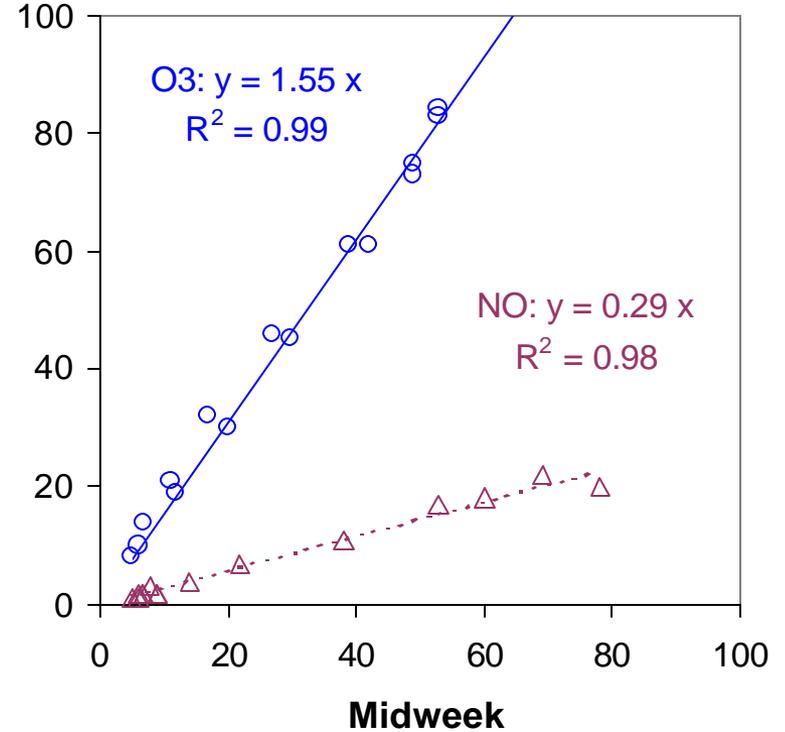


# Correlations of Saturday and Sunday Versus Midweek\* Hourly Daytime (0600 to 2000, PDT) O<sub>3</sub> and NO at Azusa, 1999-2000

## Saturday



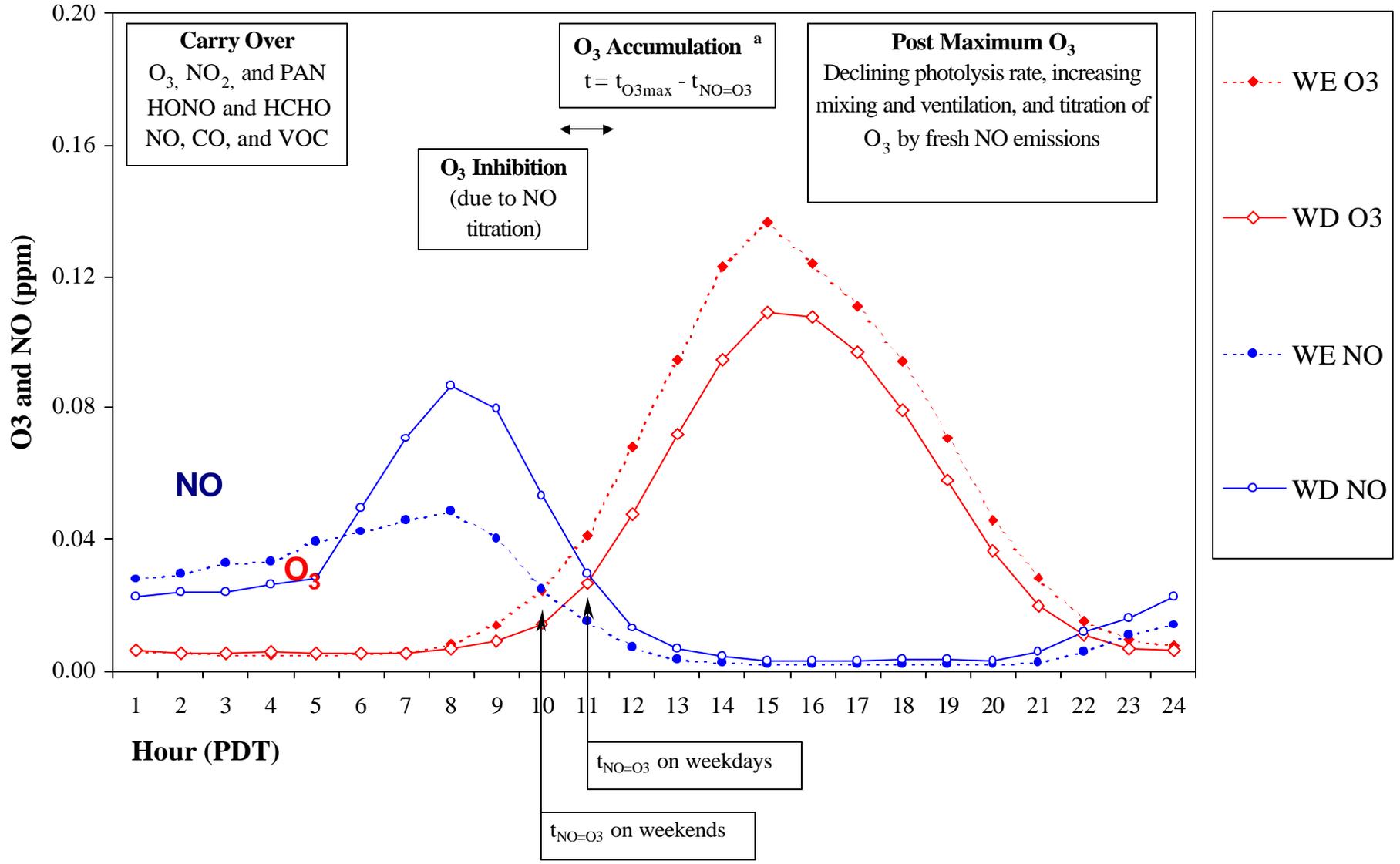
## Sunday



NO<sub>x</sub> emissions are 50% and 70% **lower** on Saturdays and Sundays, respectively, than on weekdays; ozone is 32% and 55% **higher** on Saturdays and Sundays than on weekdays.

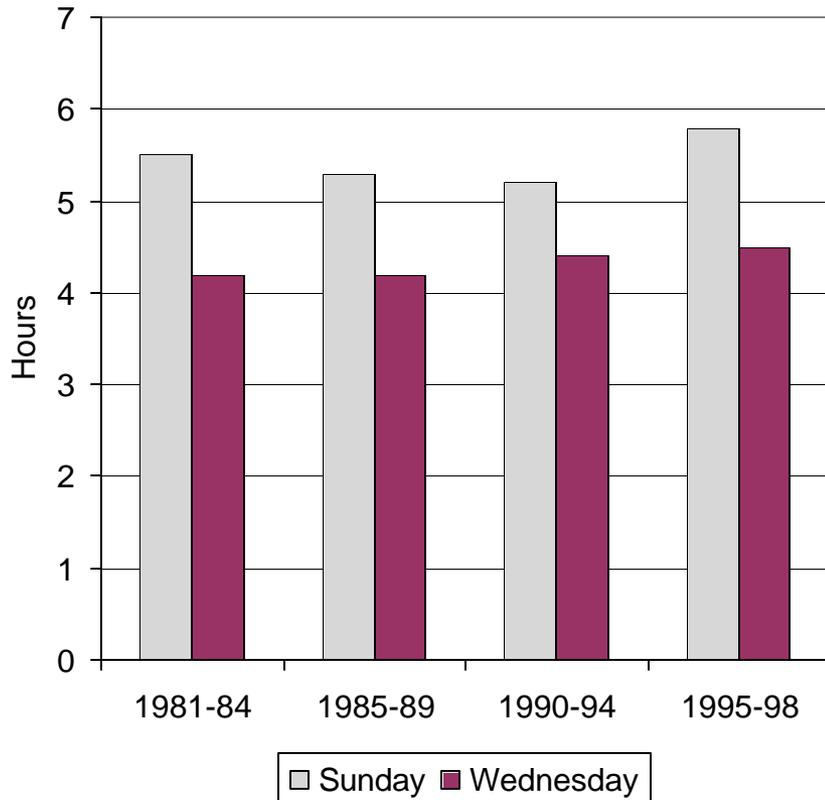
\* Tuesday to Thursday

# Azusa, Summer 1995

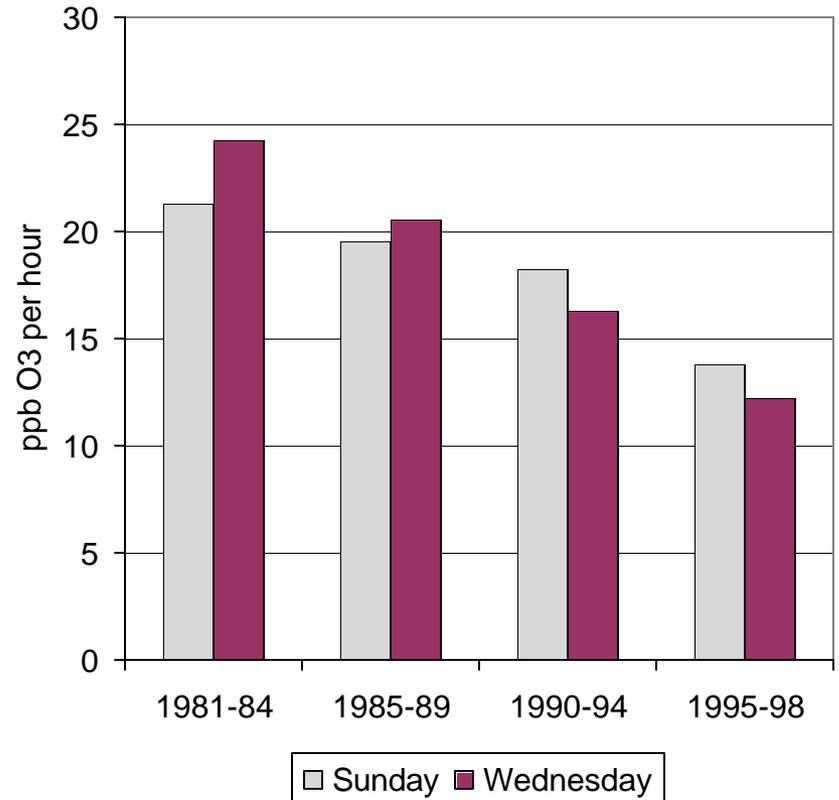


# Duration and Rate of Ozone Accumulation Mean of 12 sites in SoCAB, 1981-98

## Duration (hours)

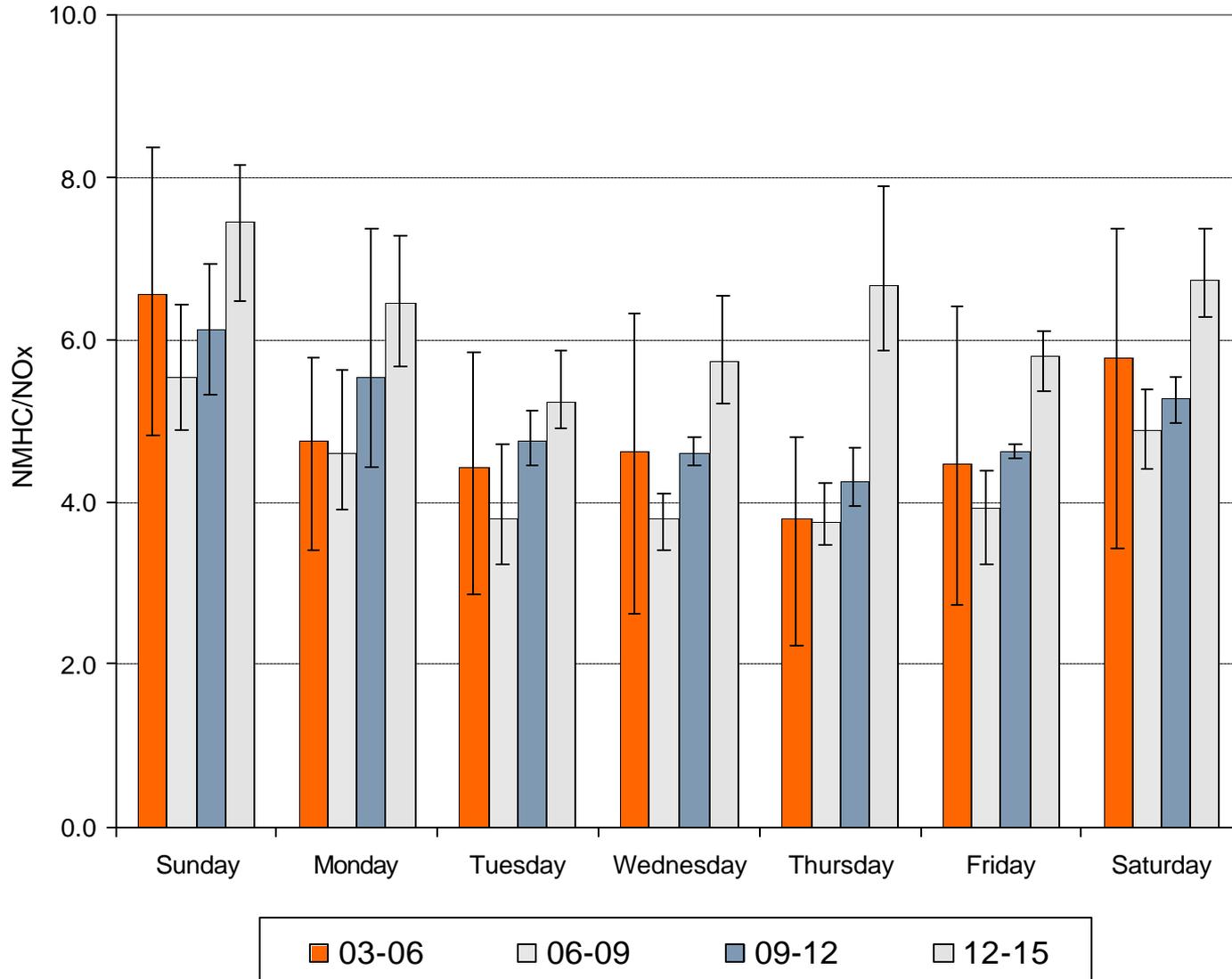


## Rate (ppb/hour)



# Weekday Variations in NMHC/NOx by Period

## Four-Site Means and Standard Deviations of the Means



# SUMMARY PART 1 OF 2

1. While ozone levels have dropped sharply in the SoCAB, highest levels now occur more frequently on weekends, with highest values on Sundays.
2. The decrease in ozone precursor concentrations on weekends is proportionately greater for NO than NMHC resulting in higher NMHC/NO<sub>x</sub> ratios.
3. Current (1999-2000) NMHC/NO<sub>x</sub> ratios in SoCAB are about half of the ratios in 1987. This decrease in ratios (and hence a decrease in ozone) is due primarily to reductions in NMHC, not decreases in NO<sub>x</sub>.
4. Ozone is higher on weekends in the SoCAB for two reasons: 1) lower early morning NO<sub>x</sub> emissions, resulting in less titration or removal of morning ozone; and 2) higher VOC or NMHC/NO<sub>x</sub> ratios, resulting in higher ozone accumulation rates.

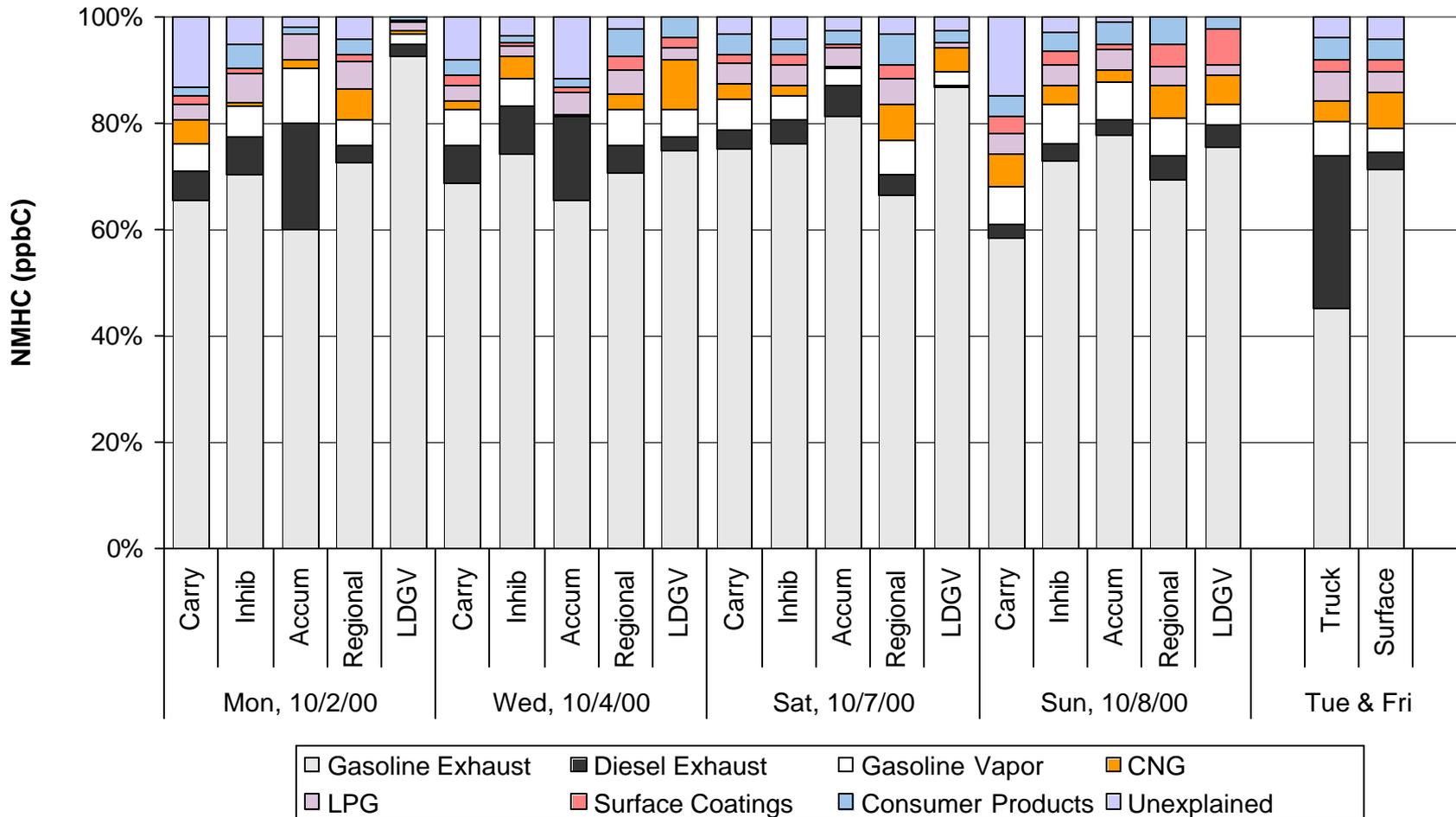
# Sampling Locations During the Fall 2000 Field Study



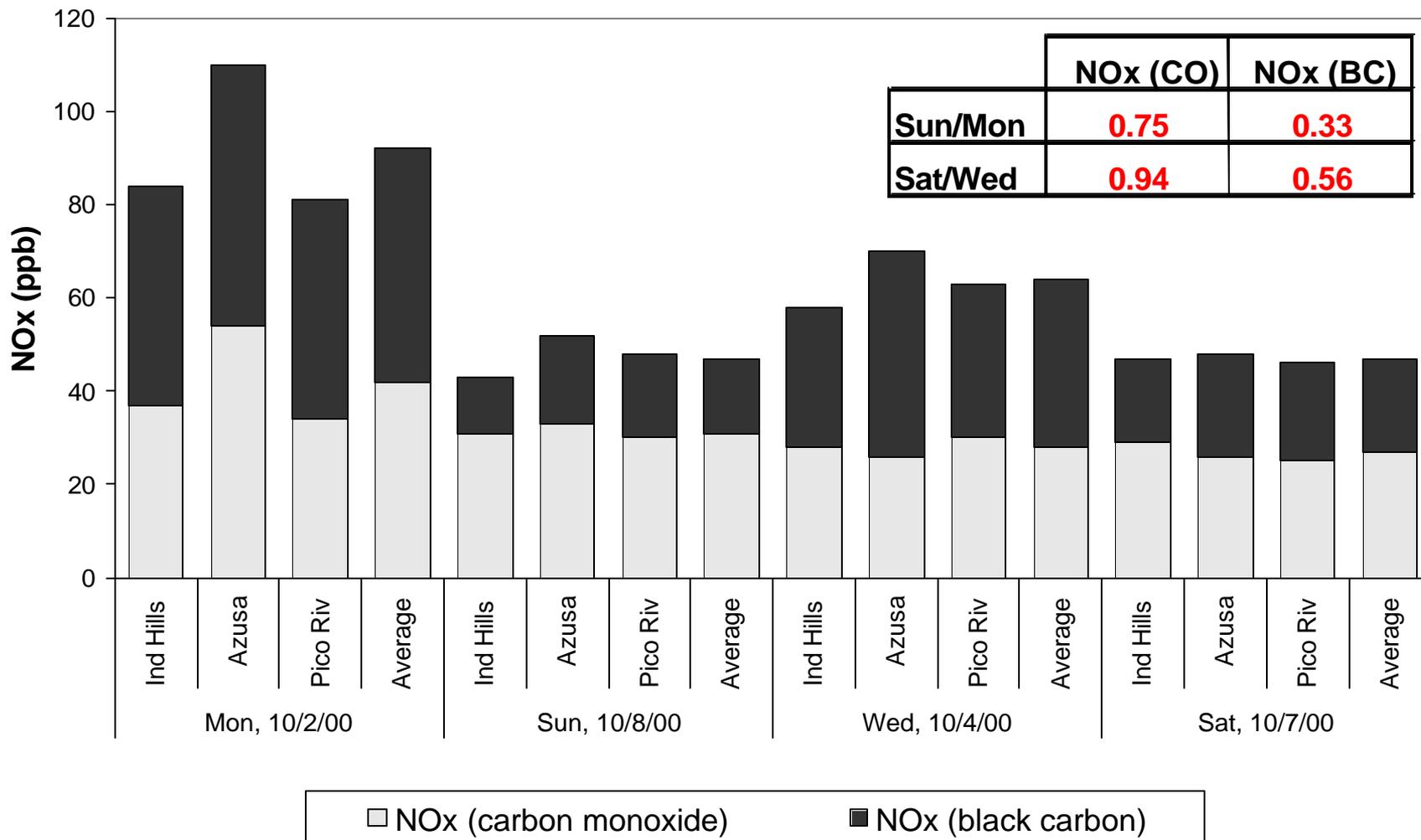
Measurements – NO, NO<sub>y</sub>, CO, C<sub>2</sub>-C<sub>12</sub> HC, C<sub>8</sub>-C<sub>18</sub> HC, and black carbon

# Source Apportionment of NMHC During Fall 2000 Field Study

## Nonmethane Hydrocarbons



# Weekend/Weekday Differences in Ambient NOx Associated with CO and Black Carbon During 9:00 a.m. to Noon

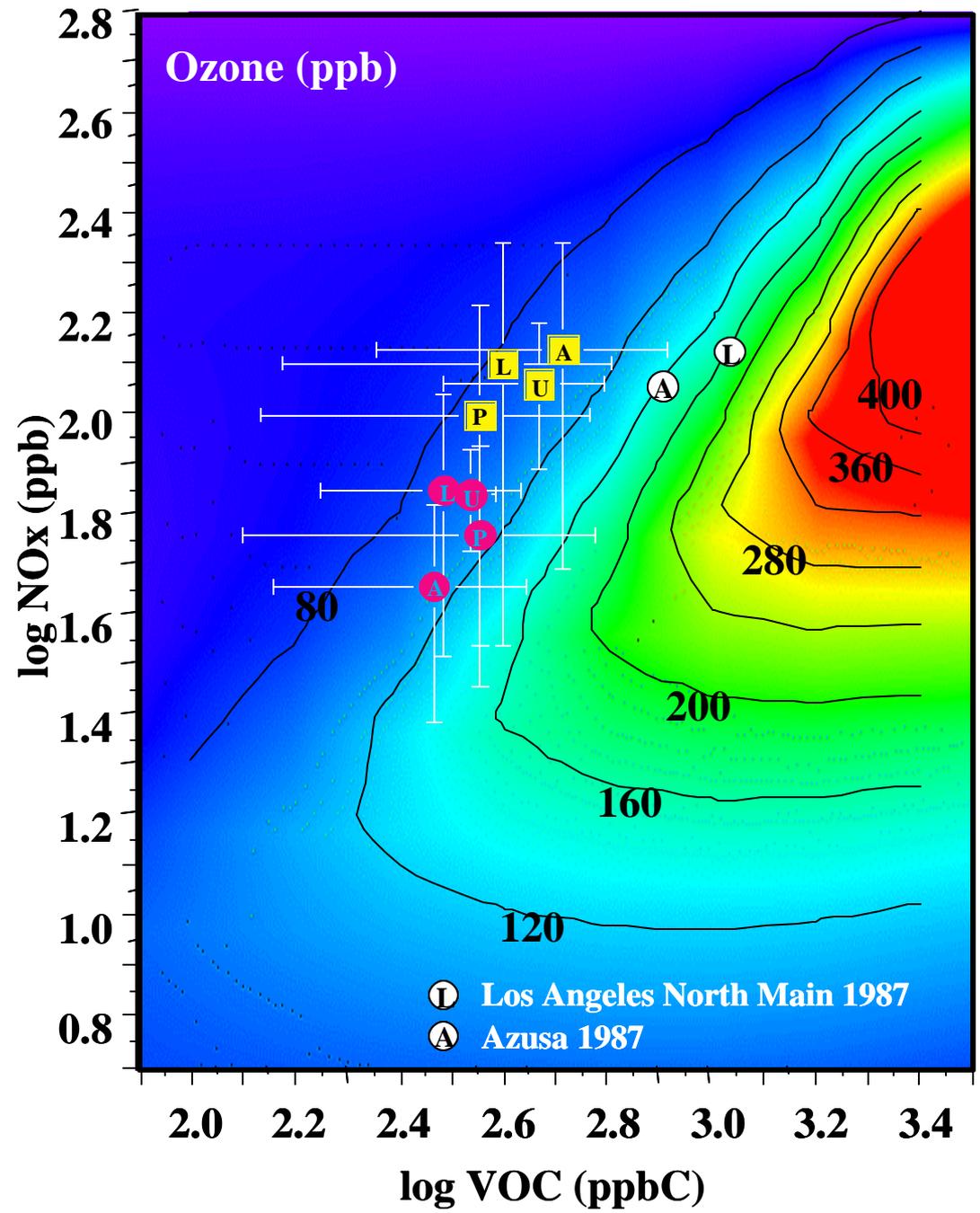


Mean Wednesday  
 $\pm 1$  sigma

Mean Sunday  
 $\pm 1$  sigma

Monitoring Stations

- A – Azusa
- L – Los Angeles, N. Main
- P – Pico Rivera
- U – Upland



# SUMMARY PART 2 OF 2

1. Gasoline exhaust and gasoline vapor account for ~80 percent of ambient NMHC in on-road samples and at regional air monitoring locations suggesting that gasoline emissions are responsible for the majority of ozone found in the SoCAB.
2. The majority of reductions in NO<sub>x</sub> emissions from mobile sources on weekends is associated with less diesel truck traffic.
3. STI investigators project that emissions of VOC and NO<sub>x</sub> in the SoCAB in 2010 are comparable to weekend emissions in 2000. If these emission projections prove to be accurate, ozone will be higher in 2010 in a large portion of the urbanized areas of SoCAB relative to current levels.
4. Ozone isopleth diagram shows that an ozone disbenefit will result if NO<sub>x</sub> emissions are decreased at current levels of VOC until ambient NO<sub>x</sub> levels are decreased by roughly 90 percent to about 10-12 ppb.