OHVT Weekend/Weekday Ozone Study in the South Coast Air Basin

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7th Diesel Engine Emission Reduction (DEER) Workshop
Portsmouth, VA
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Status of Project

Weekend/Weekday Ozone Observations in the South Coast Air Basin

- PHASE I: Retrospective Analysis of Ambient and Emissions Data
  - Draft Report 8/23/00
  - Final report 12/29/00
- PHASE II: Field Measurements
  - Field measurements by DRI in September - October 2000
  - Survey by STI of activity patterns related to emission during field study.
  - DRI Interim Report on 8/30/01
- PHASE III: Data Analysis and Final Report
  - Separate Draft Reports by STI and DRI on 12/15/01
  - Draft Combined STI and DRI Report on 3/1/02
  - Final Reports on 5/1/02

Acknowledgments

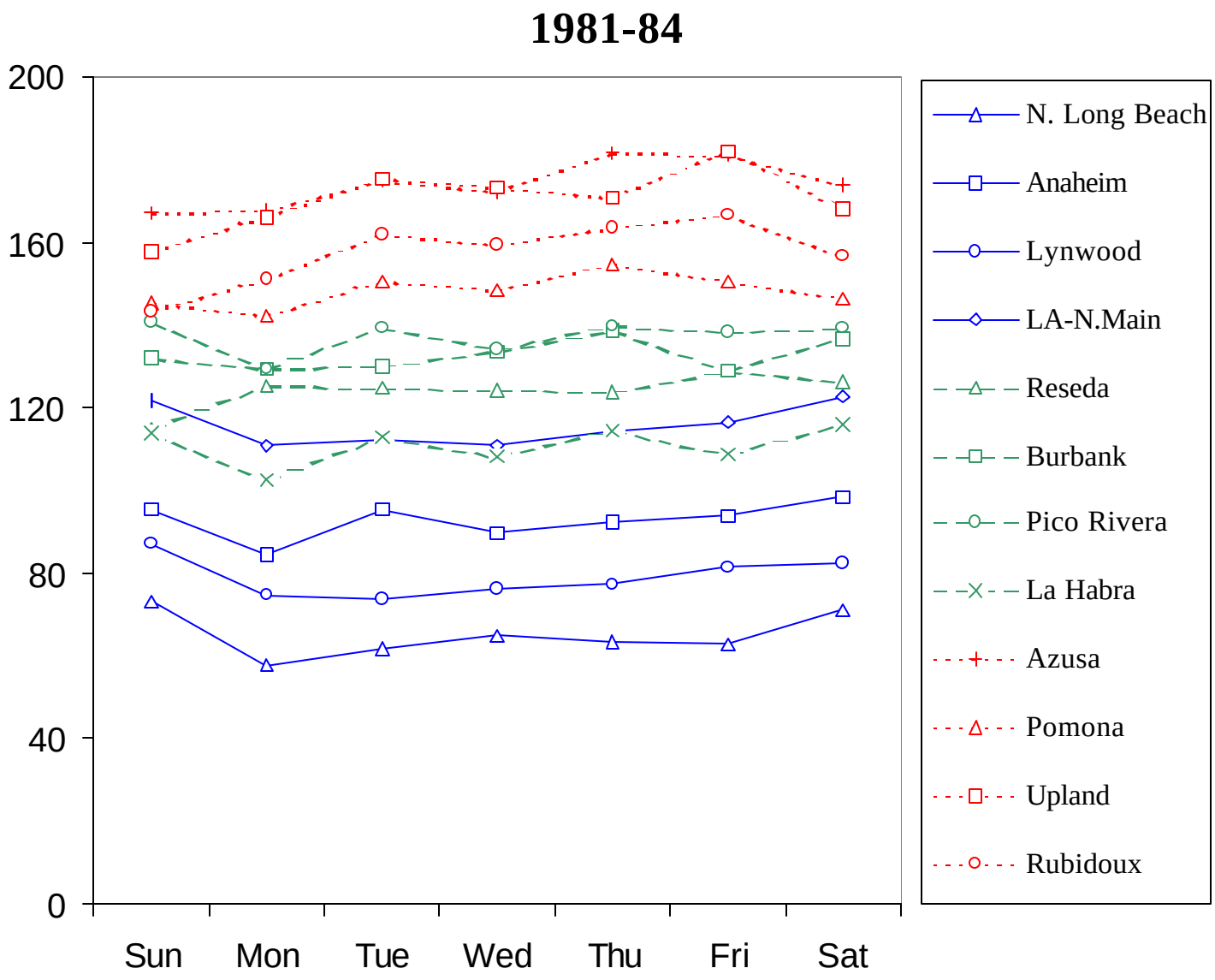
Sponsors

- Department of Energy, Office of Heavy Vehicle Technology (OHVT), Dr. James Eberhardt and Dr. Michael Gurevich
- Coordinating Research Council, Mr. Brent Bailey

Technical and Logistical Assistance

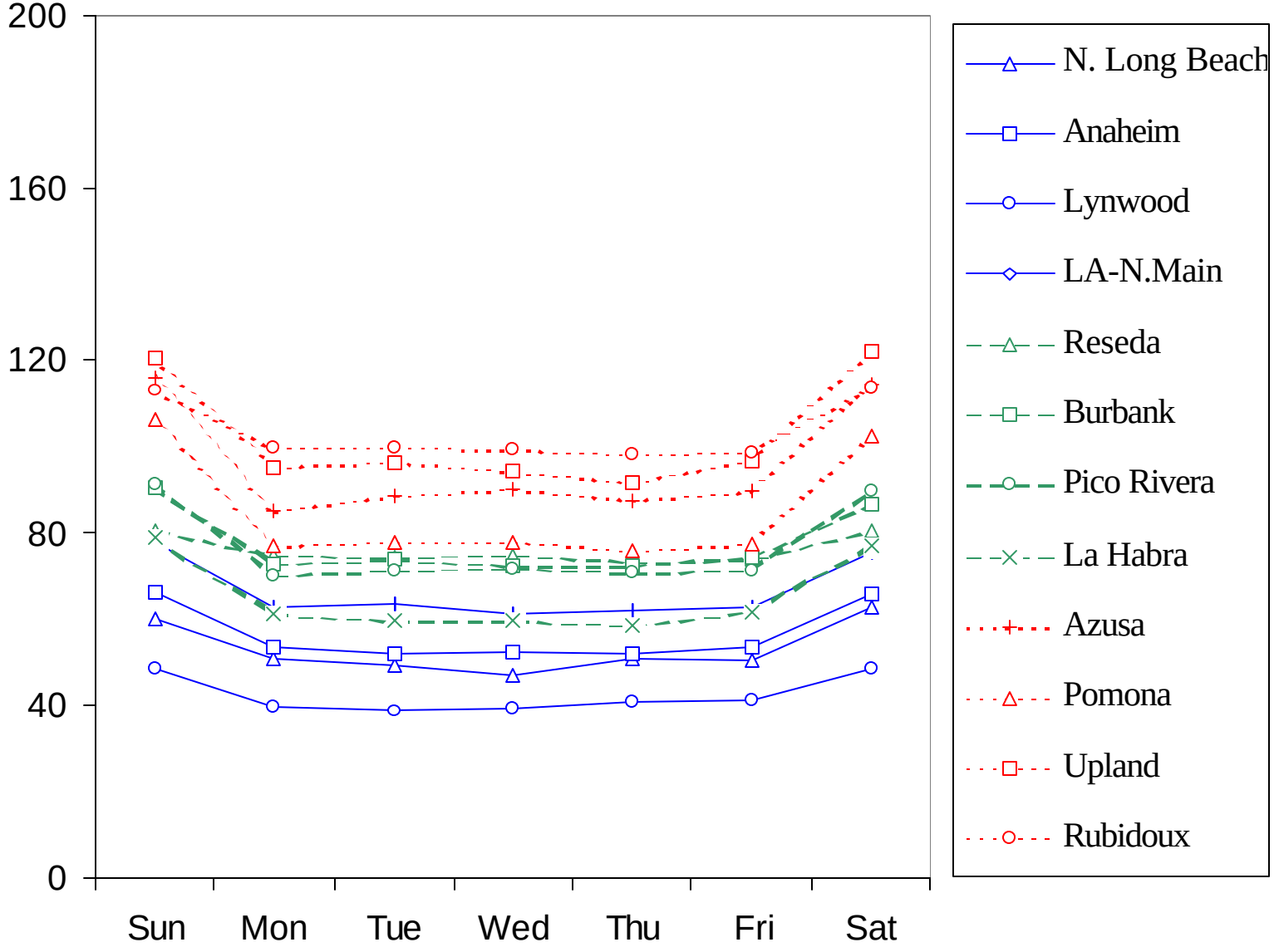
- South Coast Air Quality Management District
- California Air Resources Board
- Bay Area Air Quality Management District

Average Daily Maximum Ozone (ppb) in the SoCAB June to October

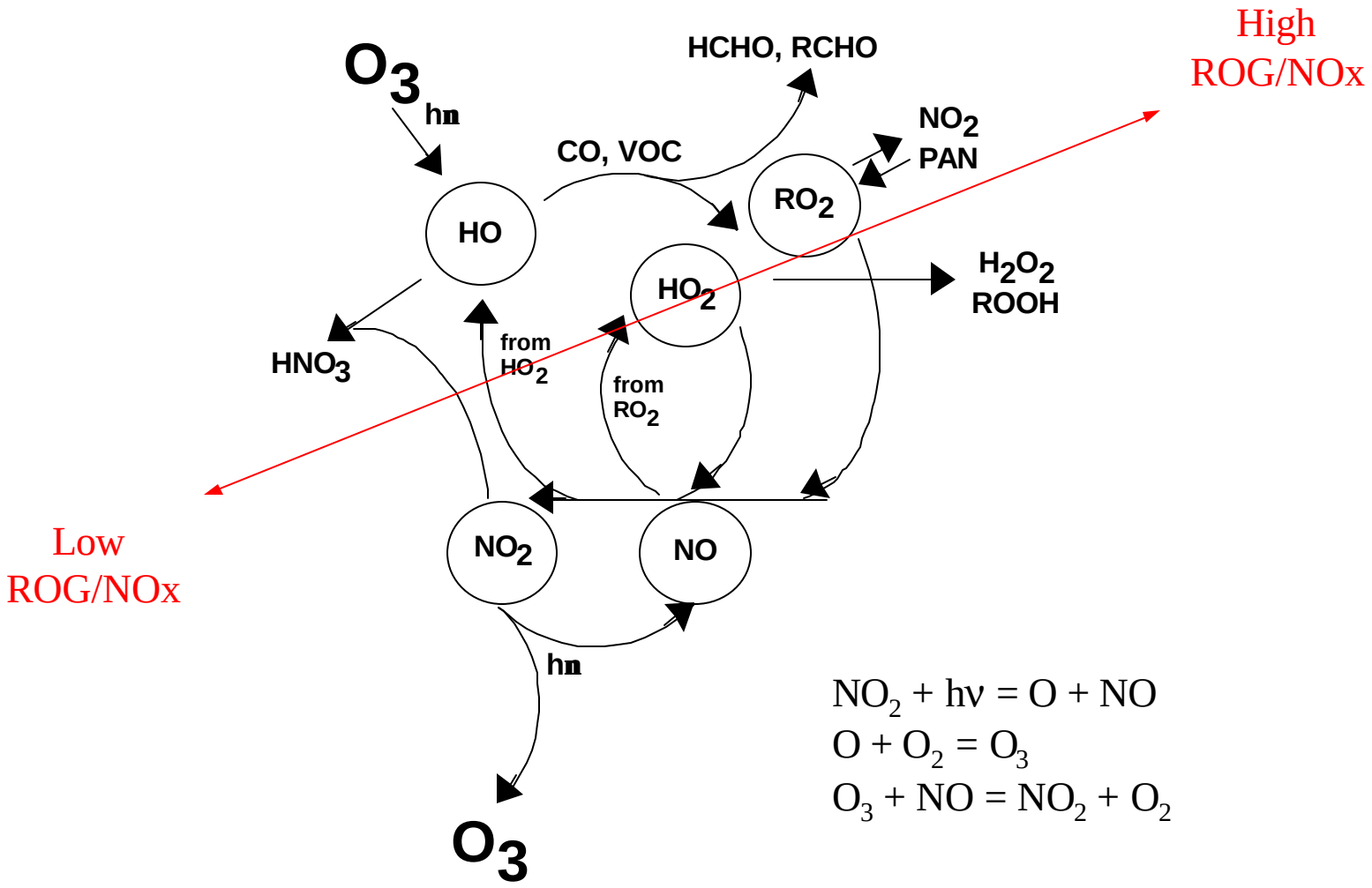


Average Daily Maximum Ozone (ppb) in the SoCAB June to October

1995-98



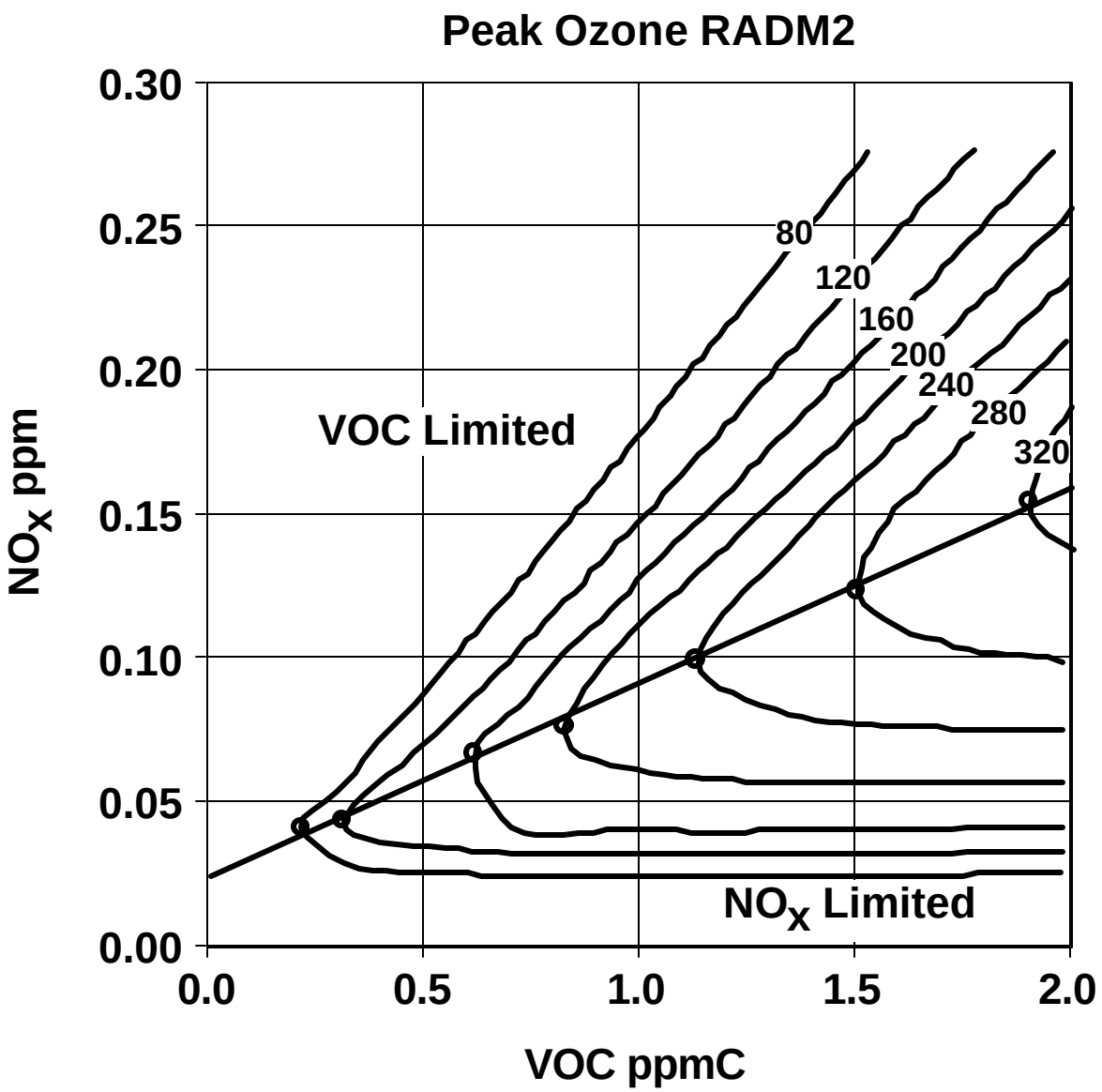
Ozone Formation Chemistry

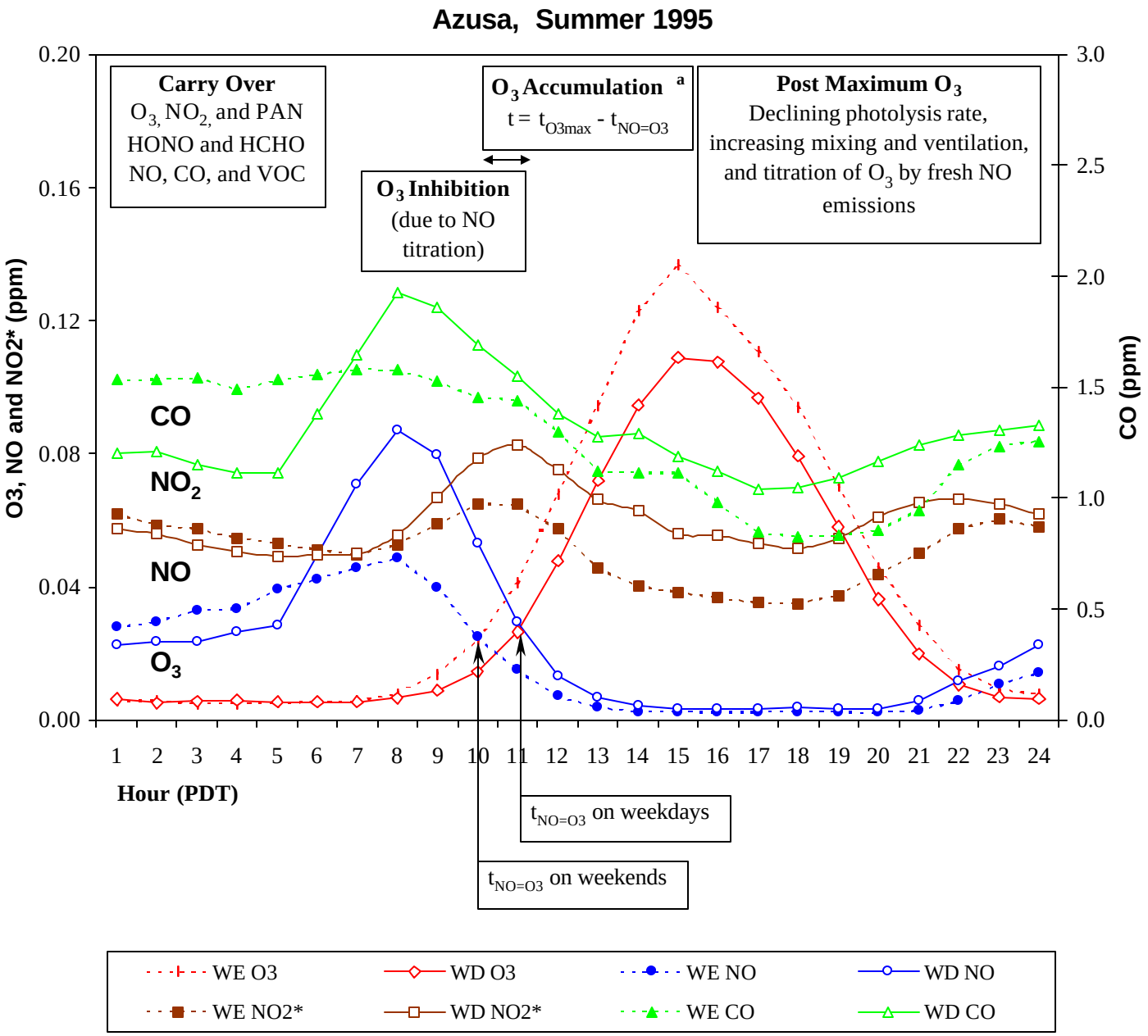


$NO_2 + h\nu = O + NO$

$O + O_2 = O_3$

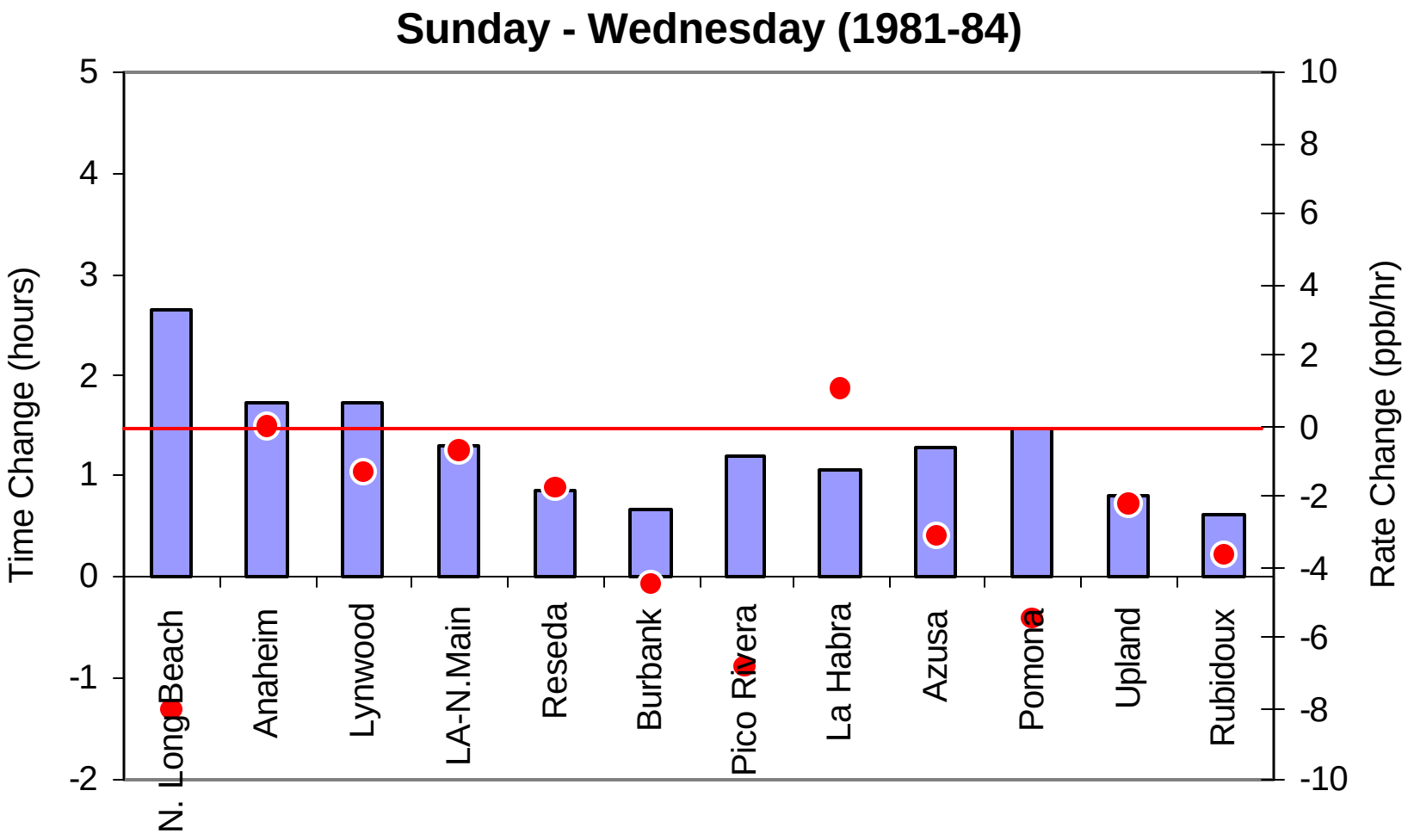
$O_3 + NO = NO_2 + O_2$


Peak Ozone RADM2
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
NOX ppm
VOC ppmC
80
120
160
200
240
280
320
VOC Limited
NOX Limited

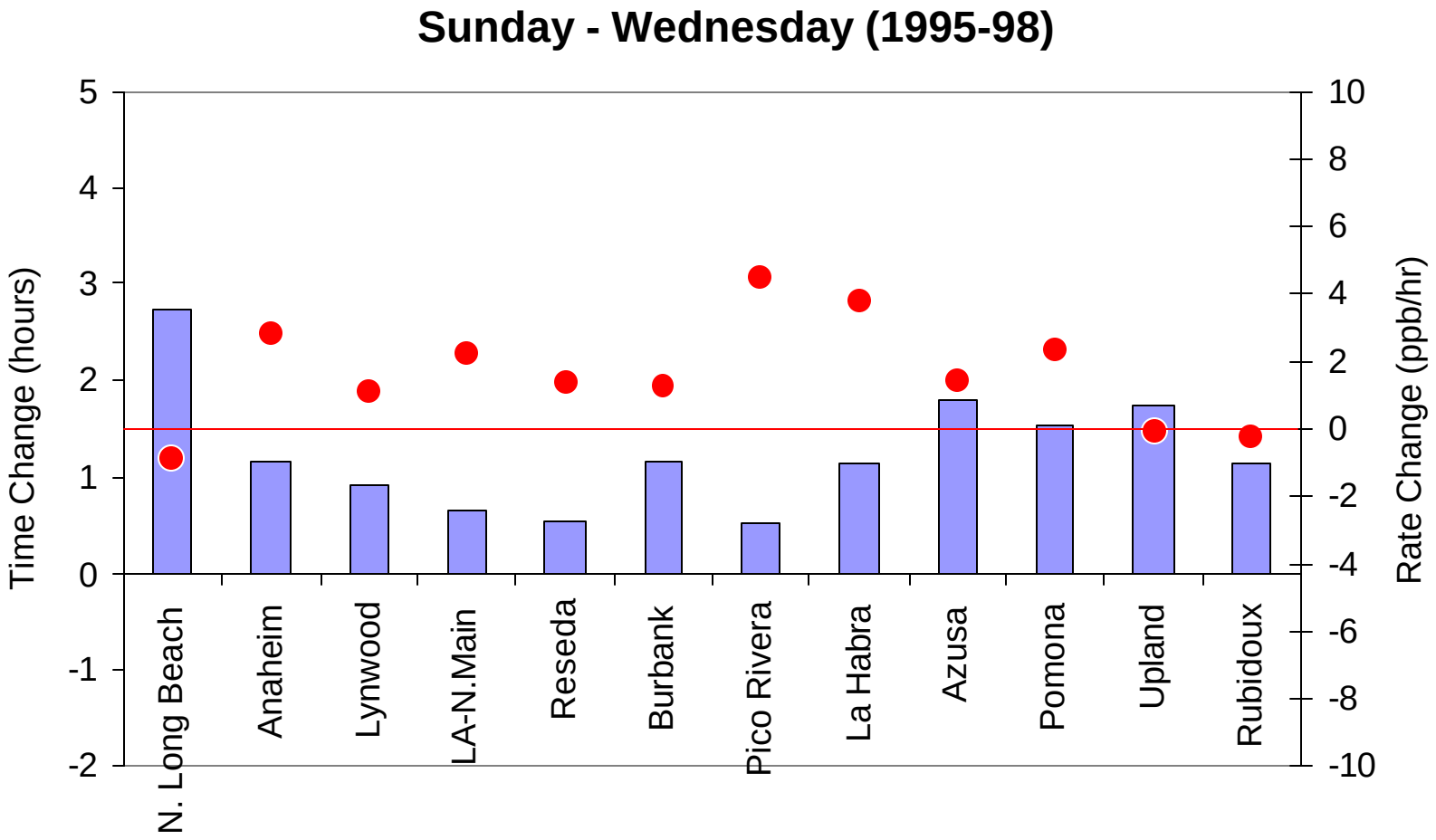


a. O3 accumulation rate = [O3(max) - O3 ($t_{NO=O3}$)]/(t_{O3max} - $t_{NO=O3}$)

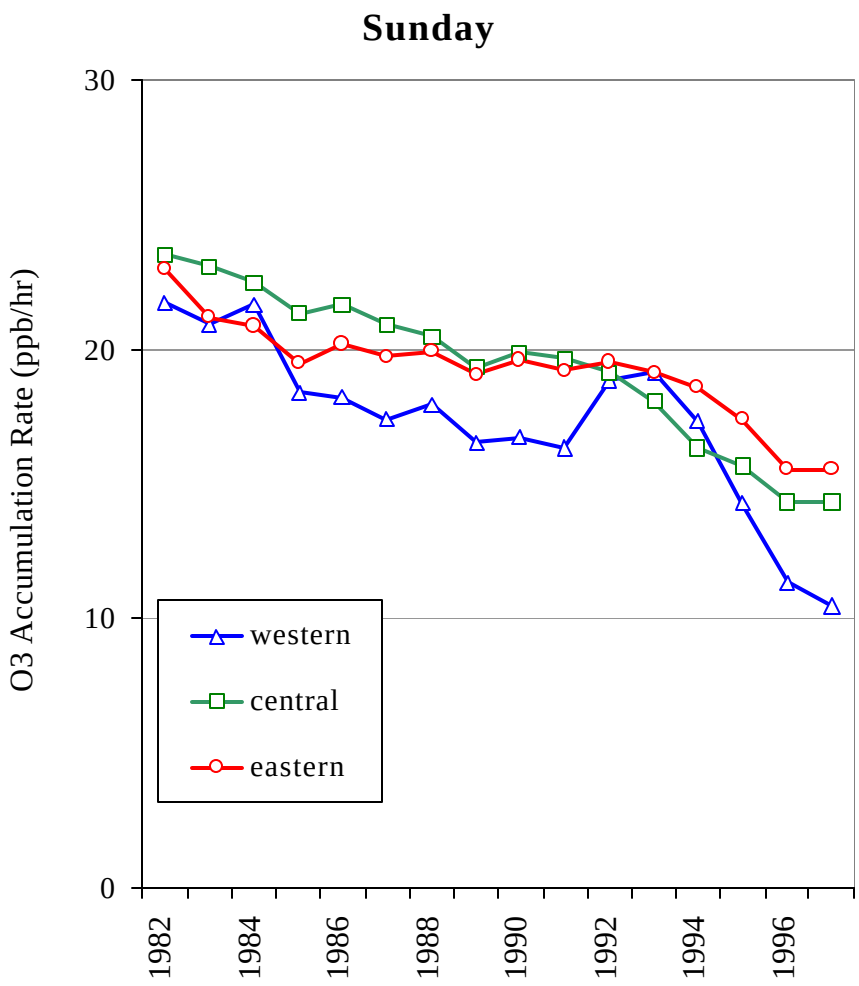
Duration (hour) and Rate (ppb/hour) of Ozone Accumulation

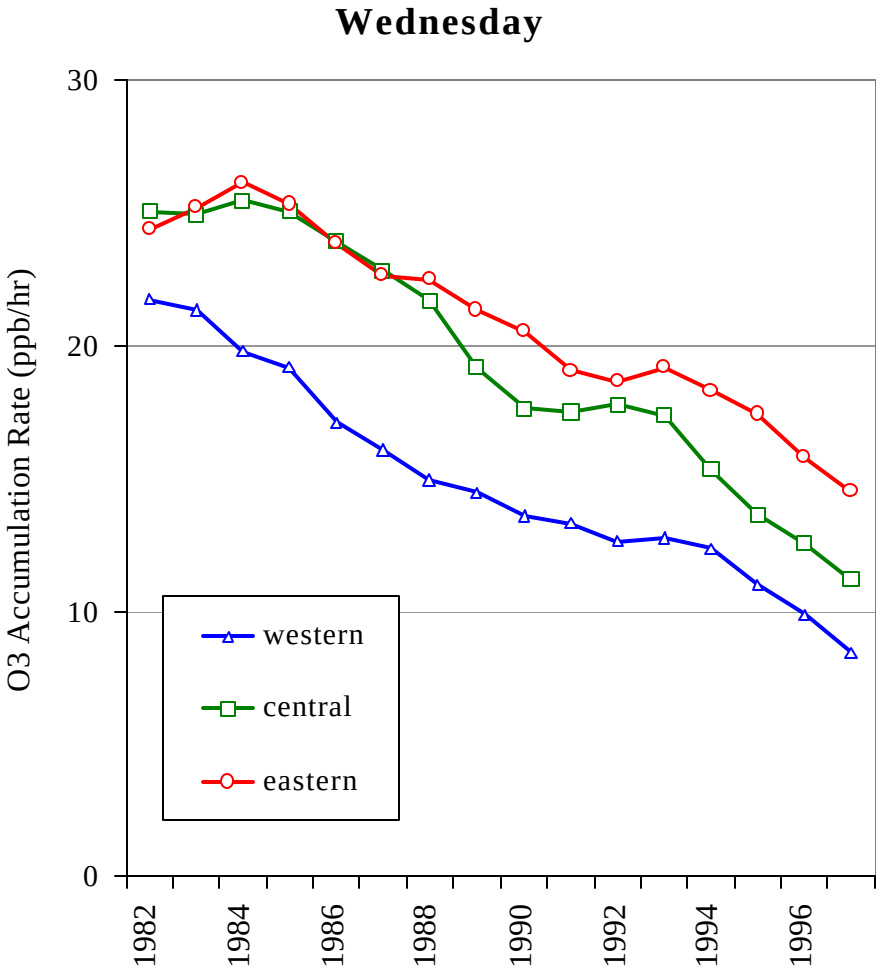


Duration (hour) and Rate (ppb/hour) of Ozone Accumulation

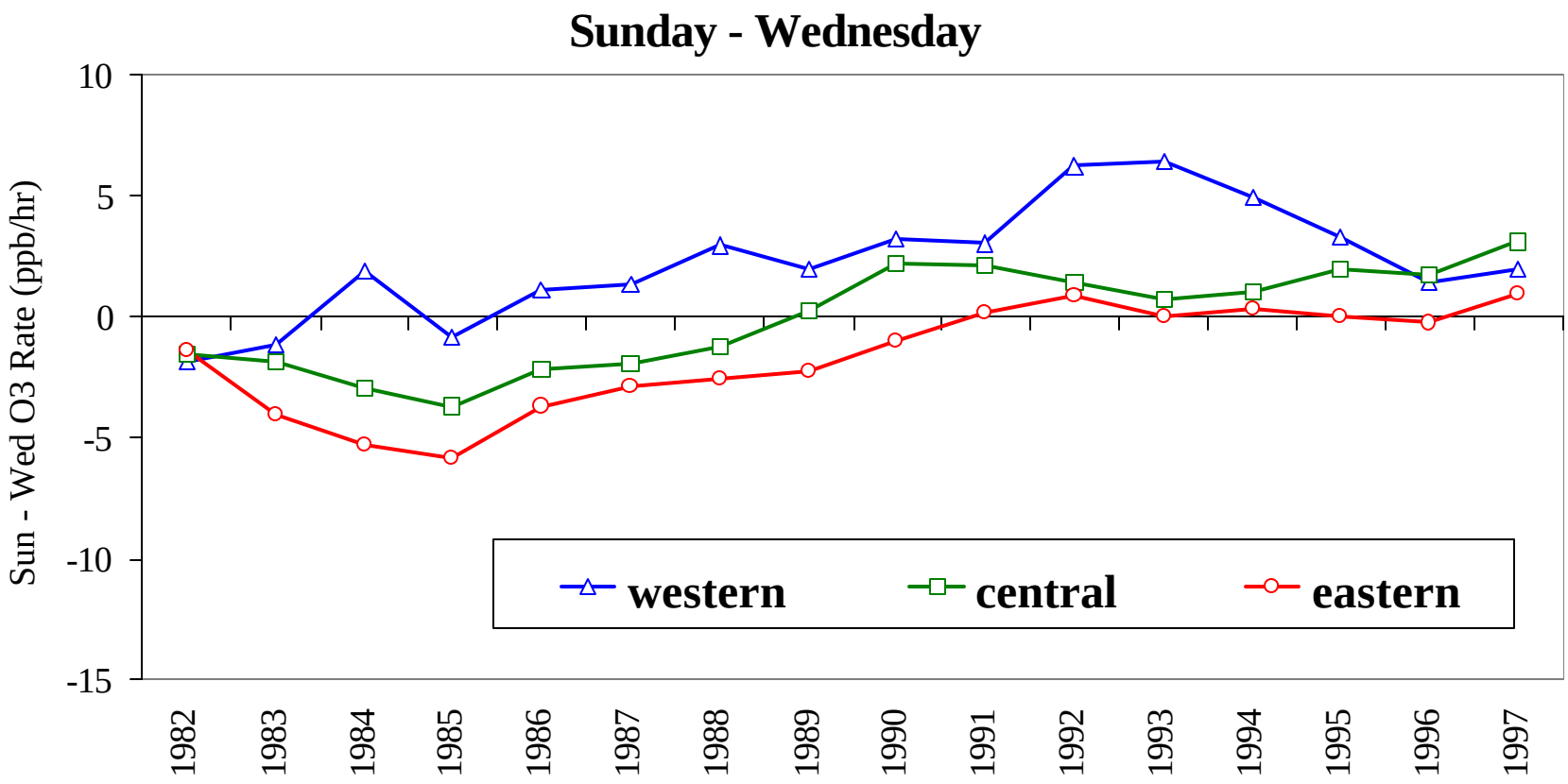


3-Year Running Averages of Ozone Accumulation Rates (ppb/hr) in the South Coast Air Basin for Sunday and Wednesday

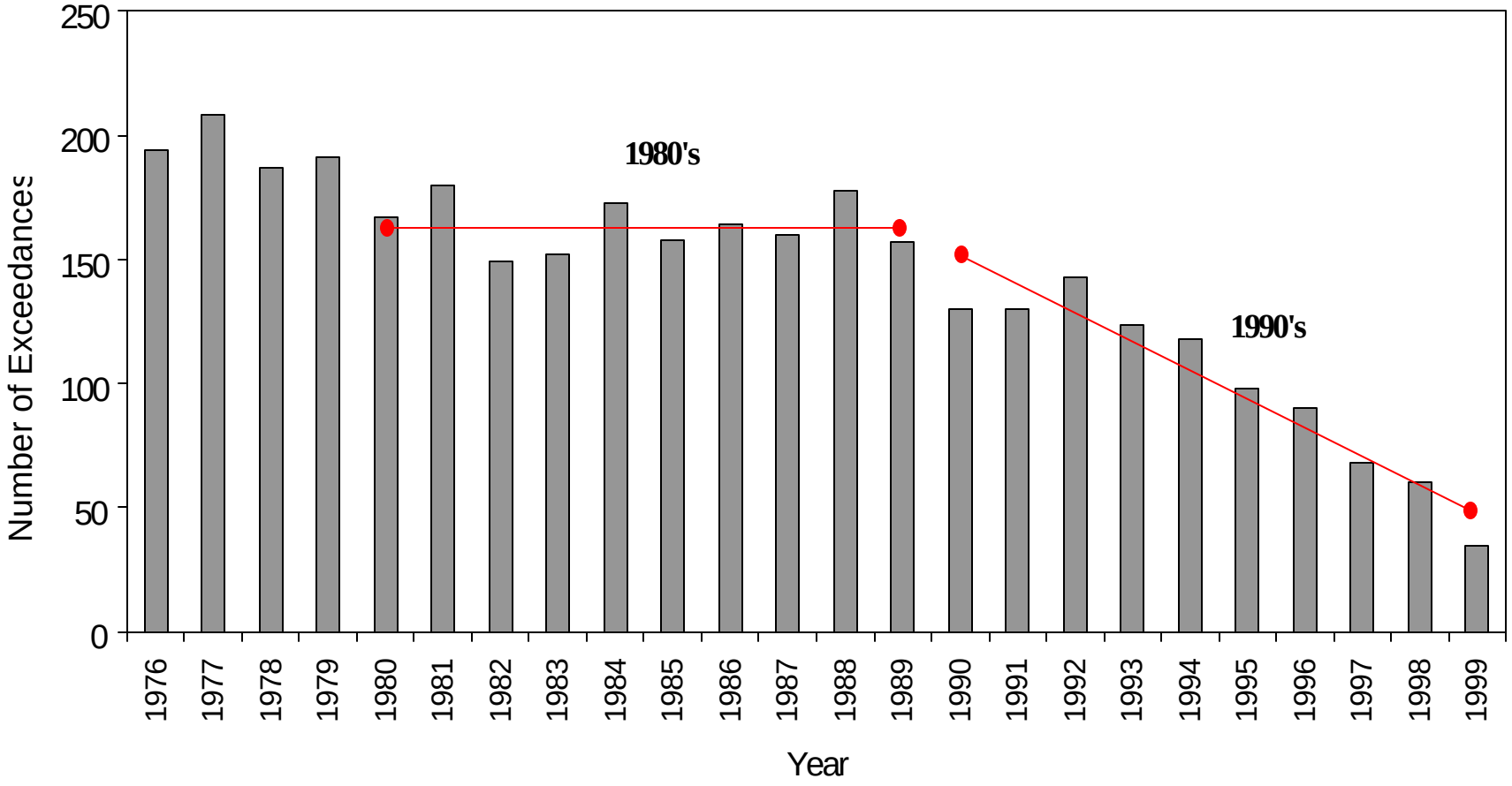




WE/WD Differences in Ozone Accumulation Rates in the SoCAB
3-Year Running Averages from 1982 to 1997



Trend in Number of Annual Exceedances of the Federal 1-hour Ozone Standard in the South Coast Air Basin from 1976 to 1999



Hypotheses for why ozone is higher on weekends

Ozone accumulates earlier on weekends mornings due to lower NO.

1. Less NO emissions from autos and trucks.
2. HONO, HCHO, and PAN are more important in initiating the formation of ozone.

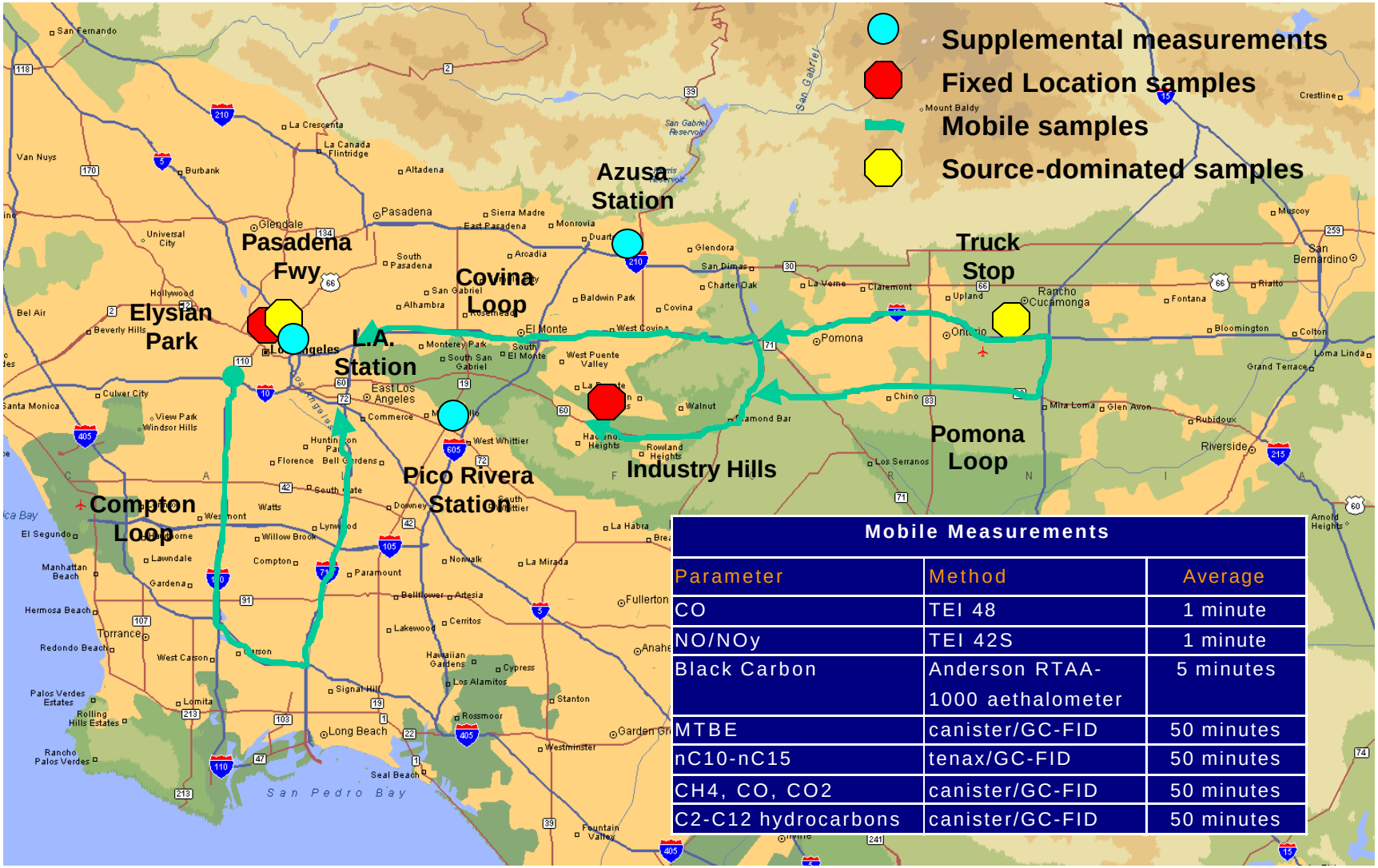
Ozone formation is faster on weekends due to higher VOC/NOx ratios.

3. Less diesel trucks traffic.
4. Carryover of VOC from auto traffic on Friday and Saturday night.
5. Mixing of aloft VOCs.
6. VOC emissions from non-mobile sources.

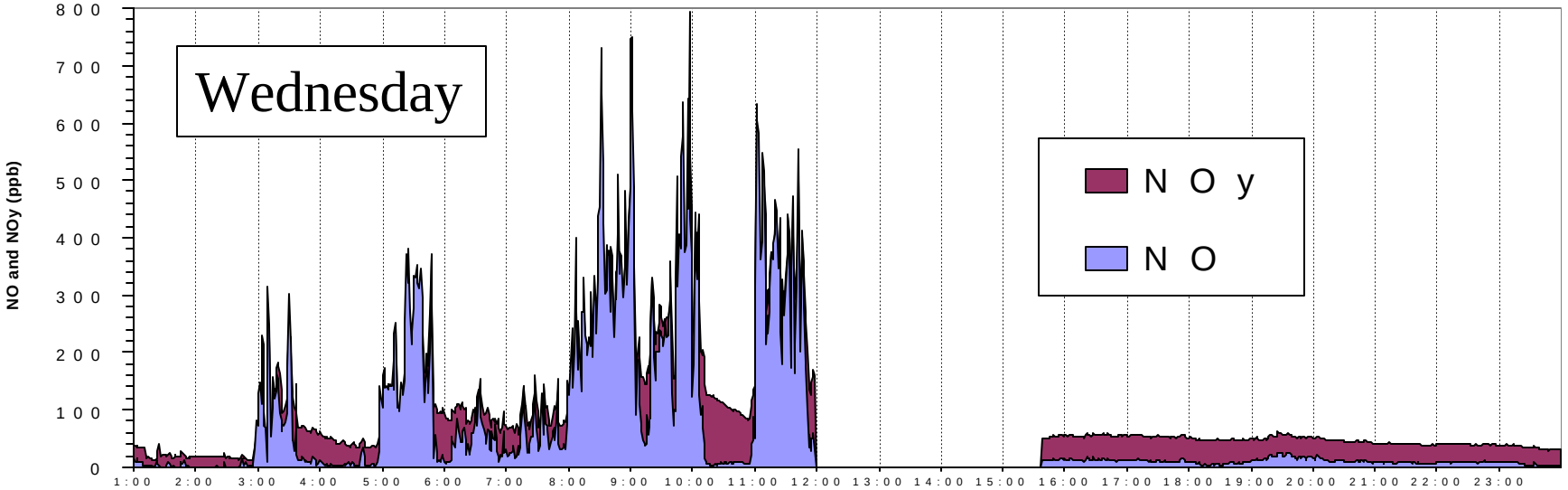
Increase photolysis rate.

7. Lower PM concentrations during weekends increases direct and scattered UV available for photolysis.

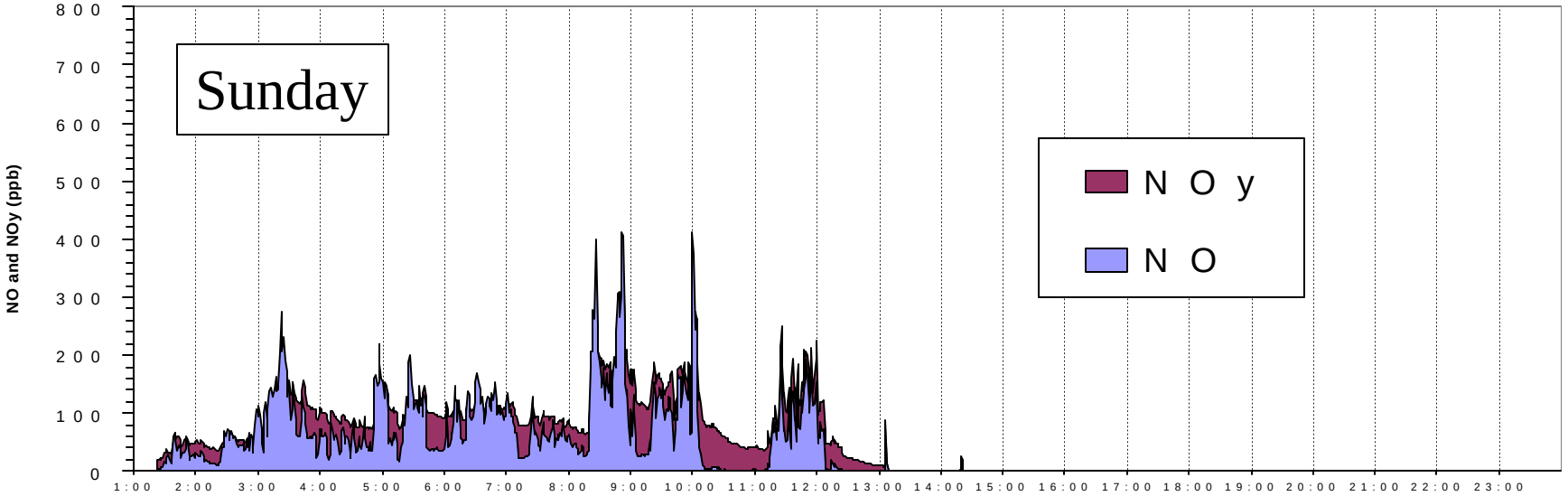
Sampling Locations During the Phase II Field Measurements



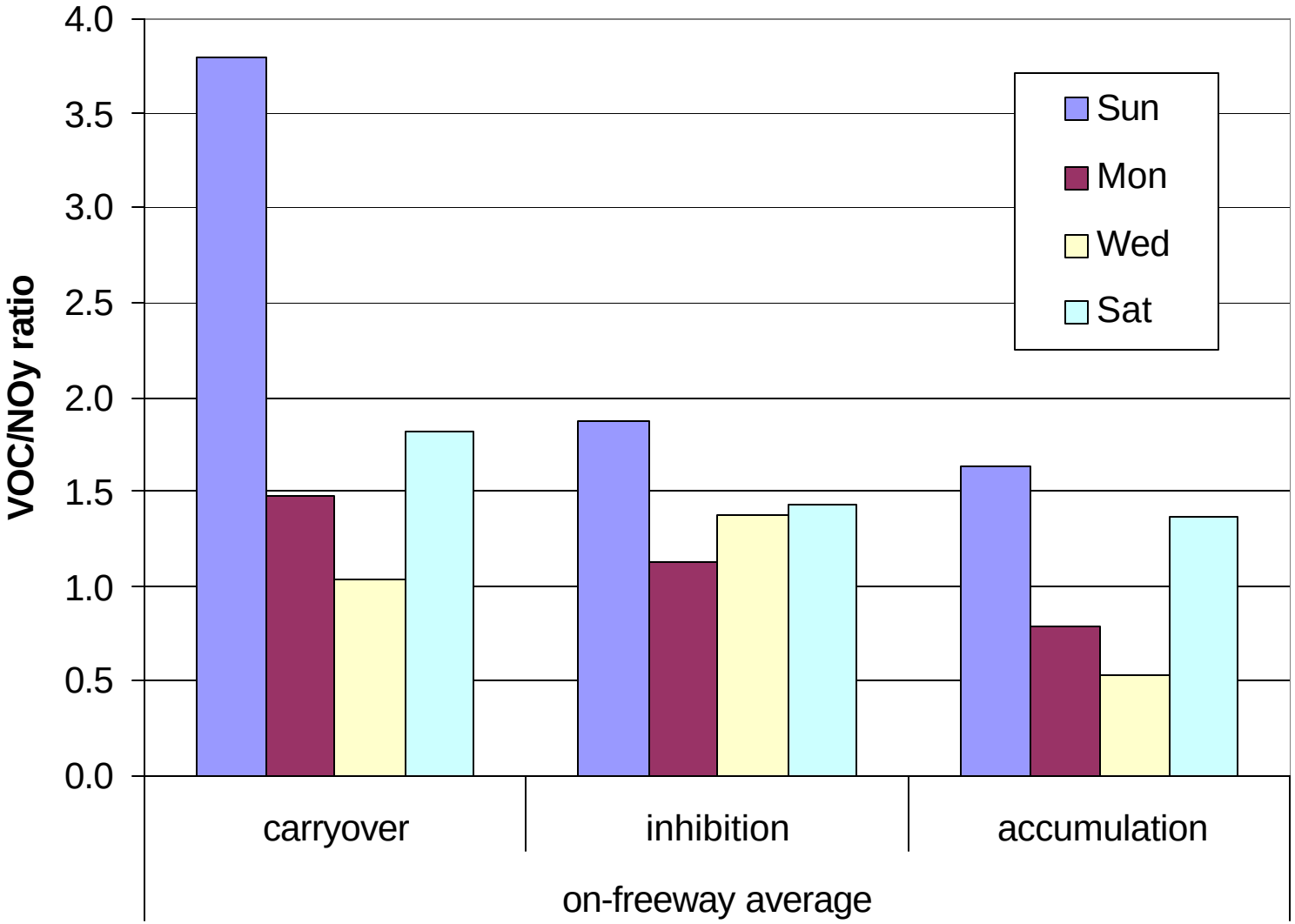
Mobile Measurements		
Parameter	Method	Average
CO	TEI 48	1 minute
NO/NOy	TEI 42S	1 minute
Black Carbon	Anderson RTAA-1000 aethalometer	5 minutes
MTBE	canister/GC-FID	50 minutes
nC10-nC15	tenax/GC-FID	50 minutes
CH4, CO, CO2	canister/GC-FID	50 minutes
C2-C12 hydrocarbons	canister/GC-FID	50 minutes



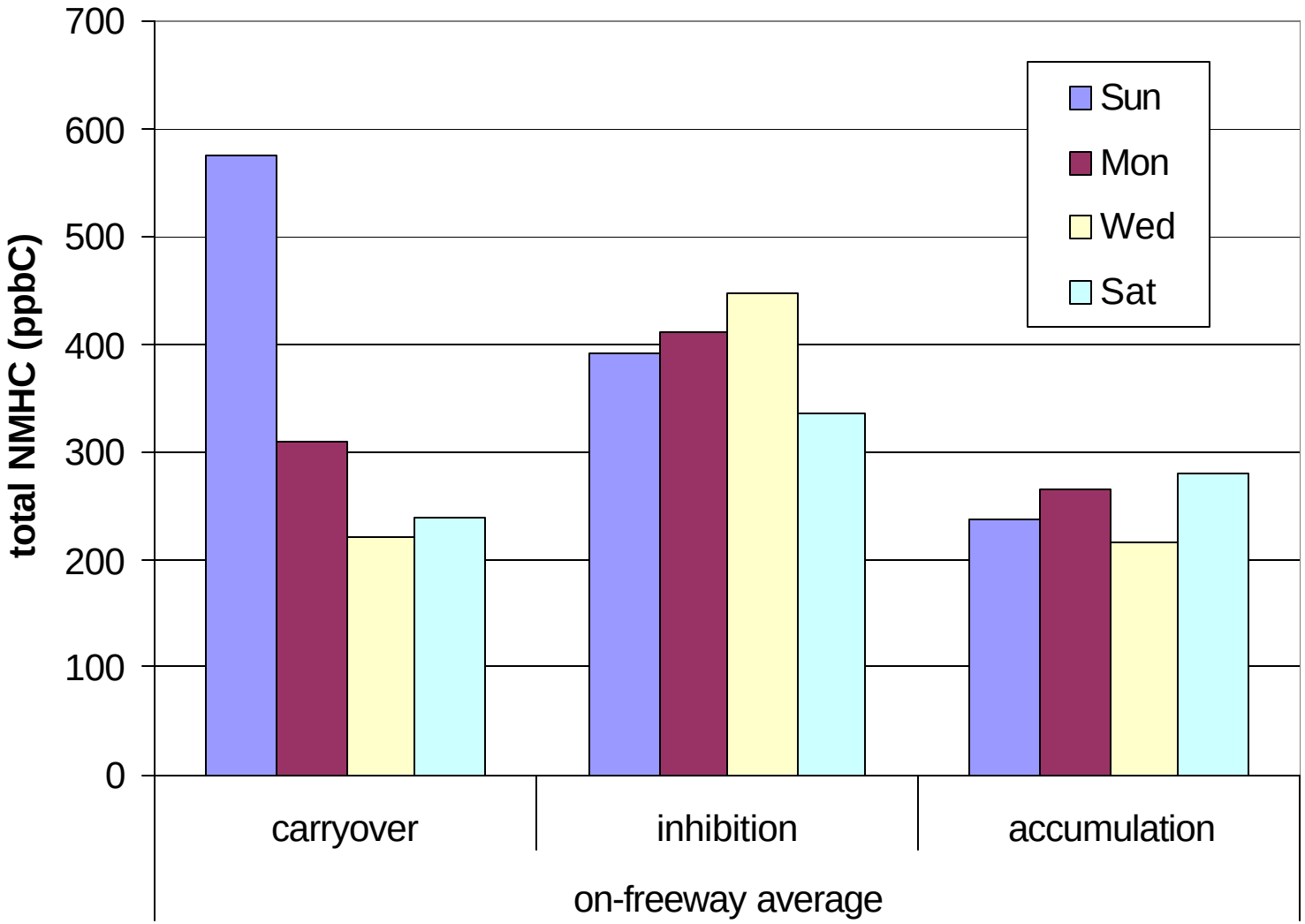
IH1 DS1 LDV Compton2 IH2 parked at Azusa AQMD station —>
Covina1 Compton1 DS2 Covina2 Pomona



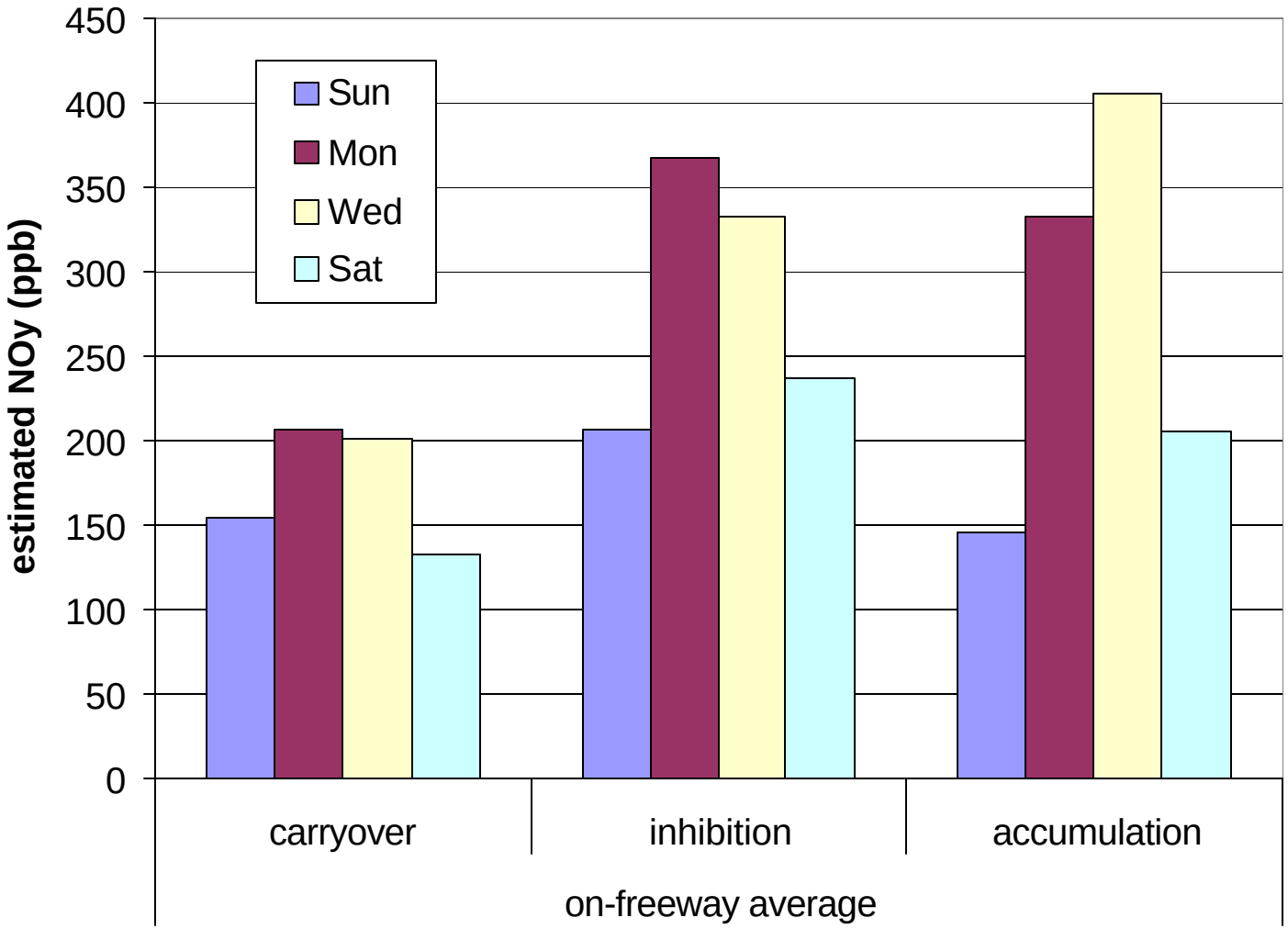
VOC/NOy Ratios on Freeway Loops



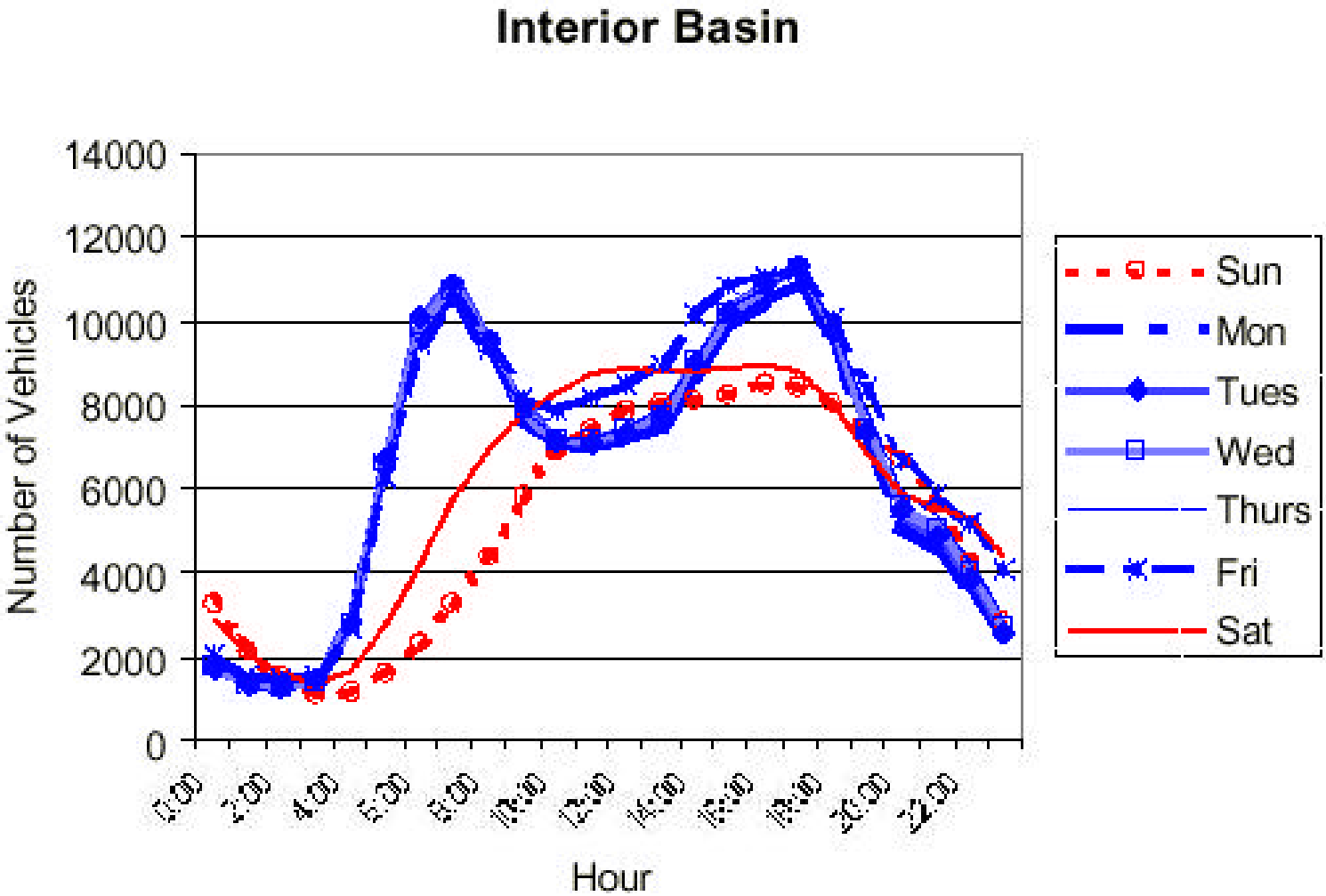
VOC Concentrations (ppbC) on Freeway Loops



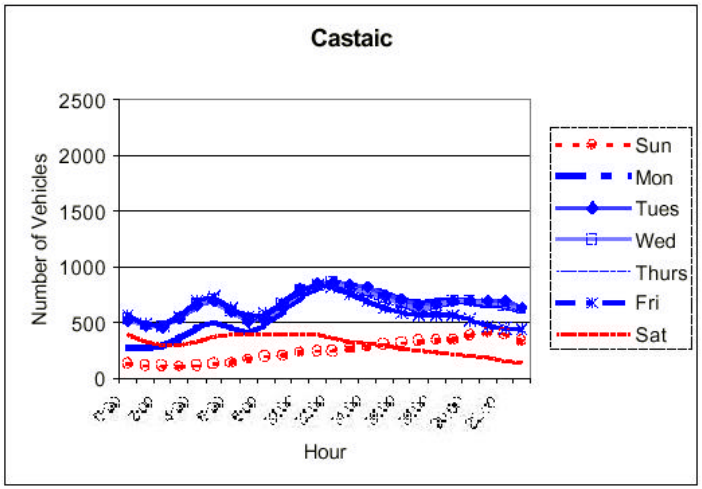
NOy Concentrations (ppb) on Freeway Loops

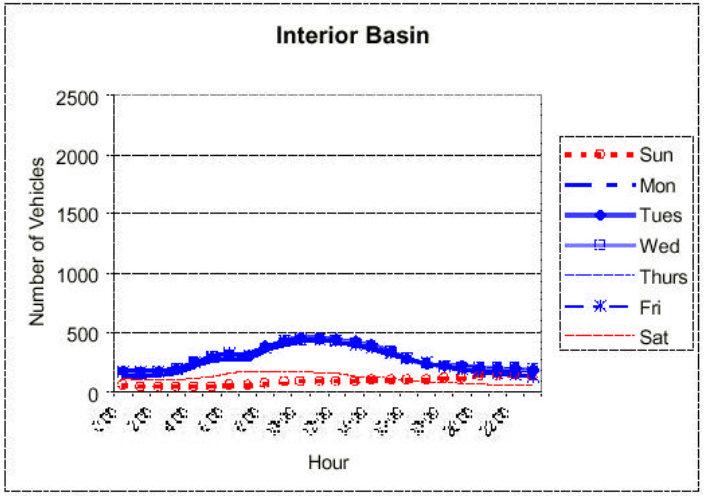


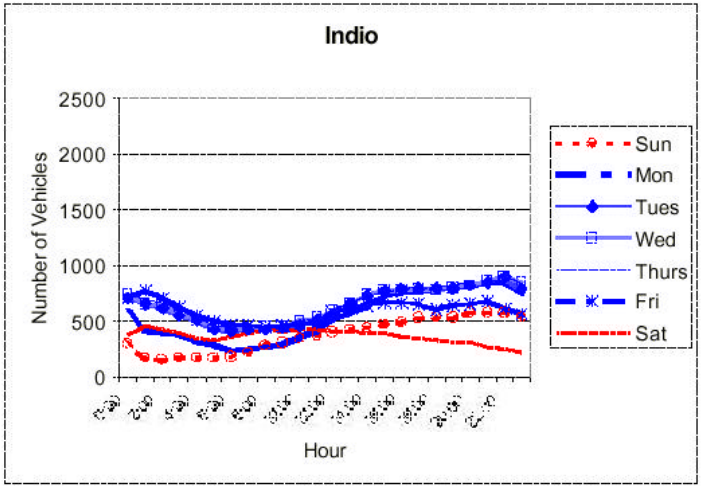
Weekday / Weekend LDV Traffic Volume on Freeways

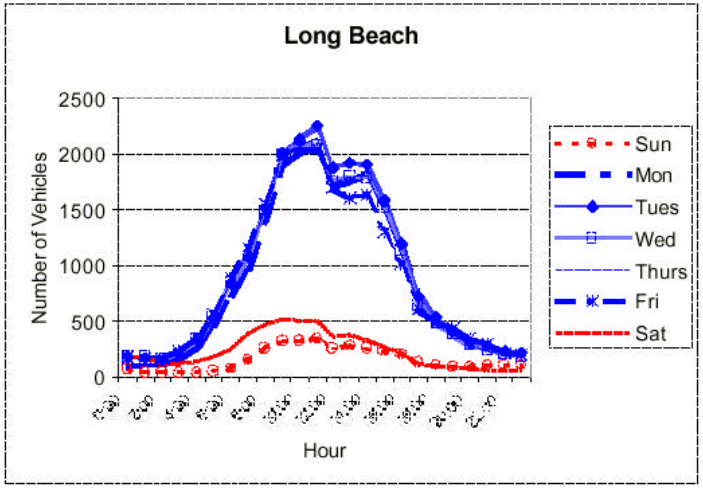


Weekday / Weekend HDV Traffic Volume on Freeways









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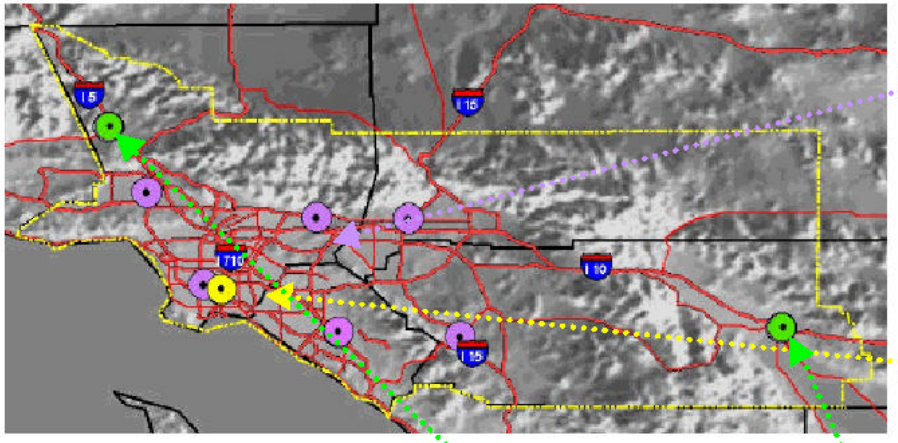
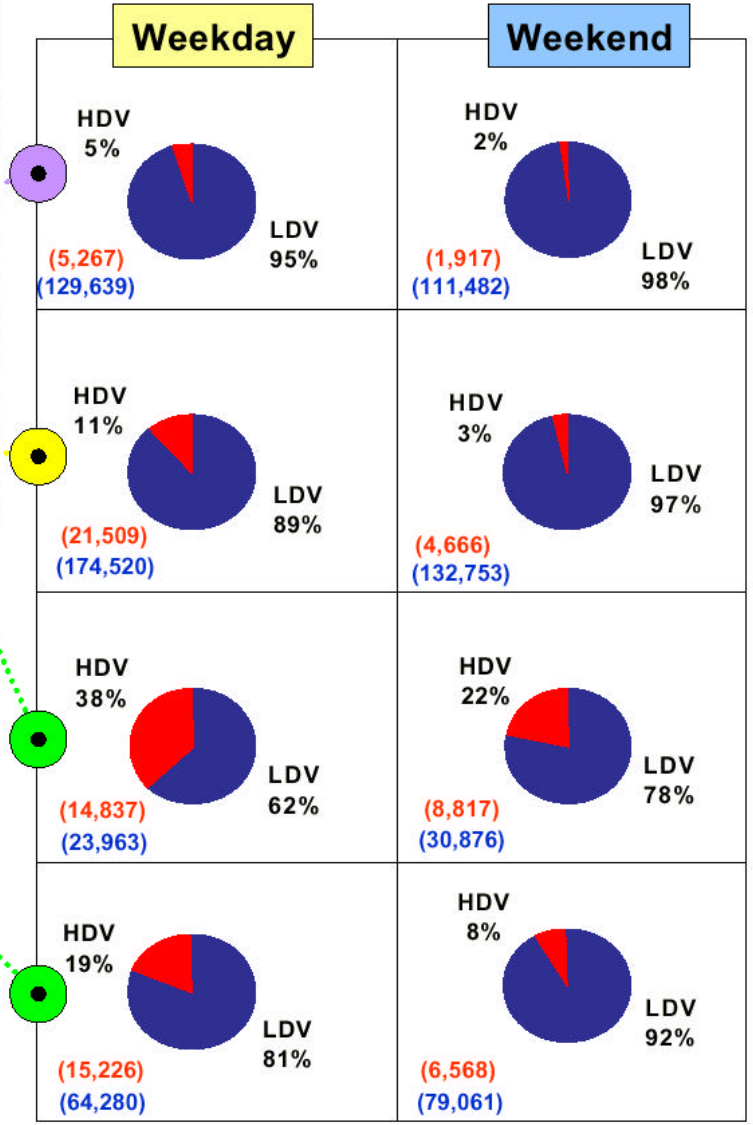
Fleet Mix - Freeways





- Interior basin low HDV
- Long Beach higher HDV - port
- Inflow / outflow sites high HDV
  LDV slightly higher on weekends

Average Daily Traffic Counts

STi
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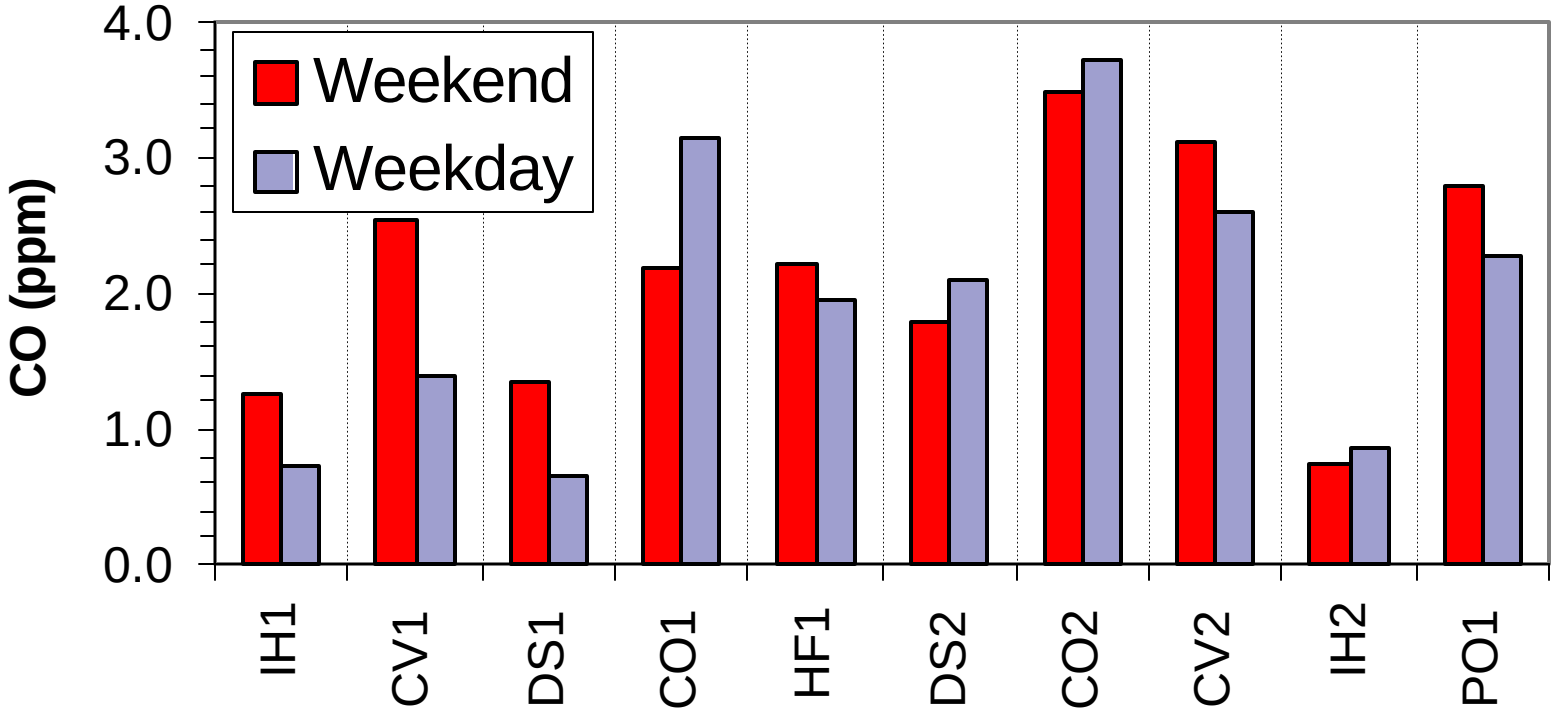
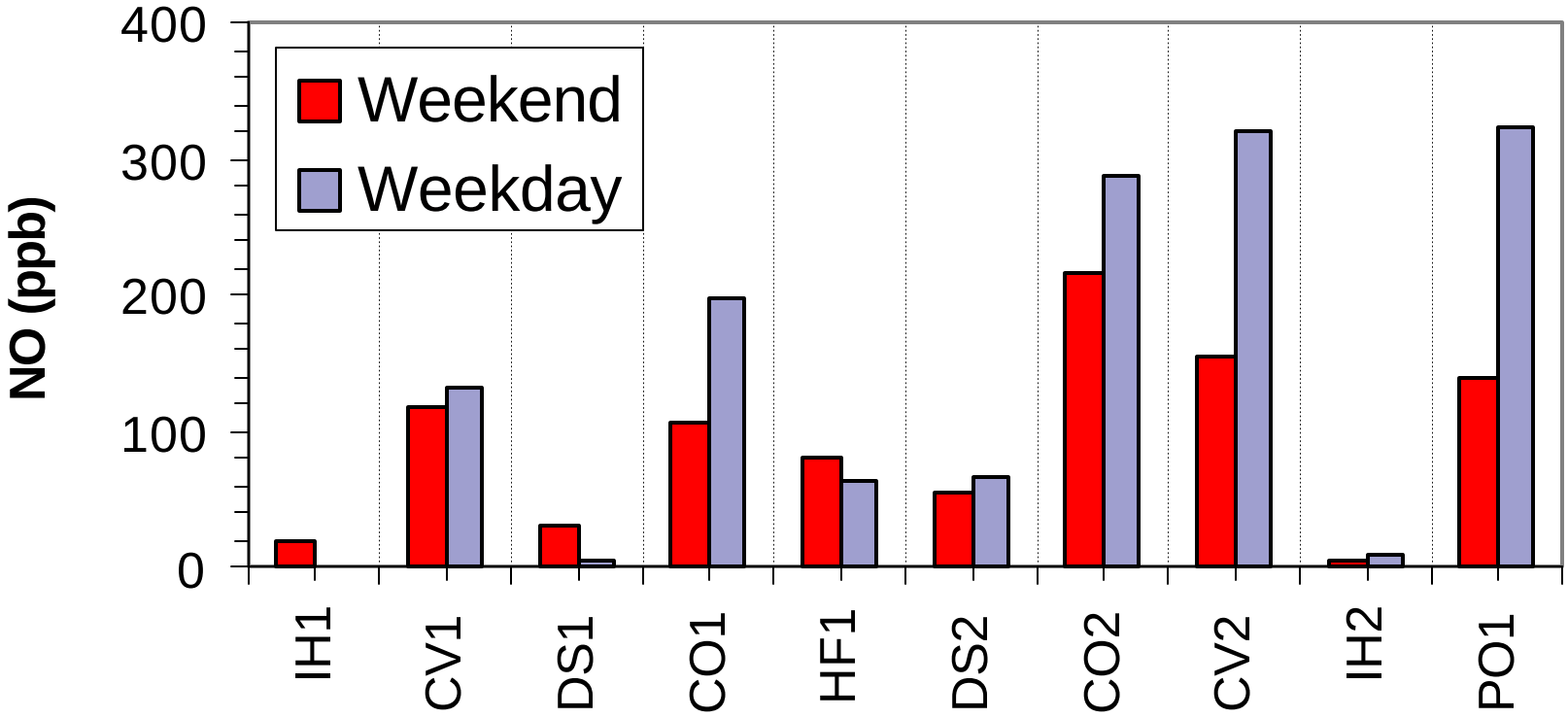
Carbon Monoxide



Location	start time	Name	Location	start time	Name
IH1	2:00	Industry Hills 1	DS2	7:00	Dodger Stadium 2
CV1	3:00	Covina 1	CO2	8:00	Compton 2
CO1	4:00	Compton 1	CV2	9:00	Covina 2
DS1	5:00	Dodger Stadium 1	IH2	10:00	Industry Hills 2
HF1	6:00	Harbor Freeway (cars only)	PO1	11:00	Pomona

Nitric Oxide



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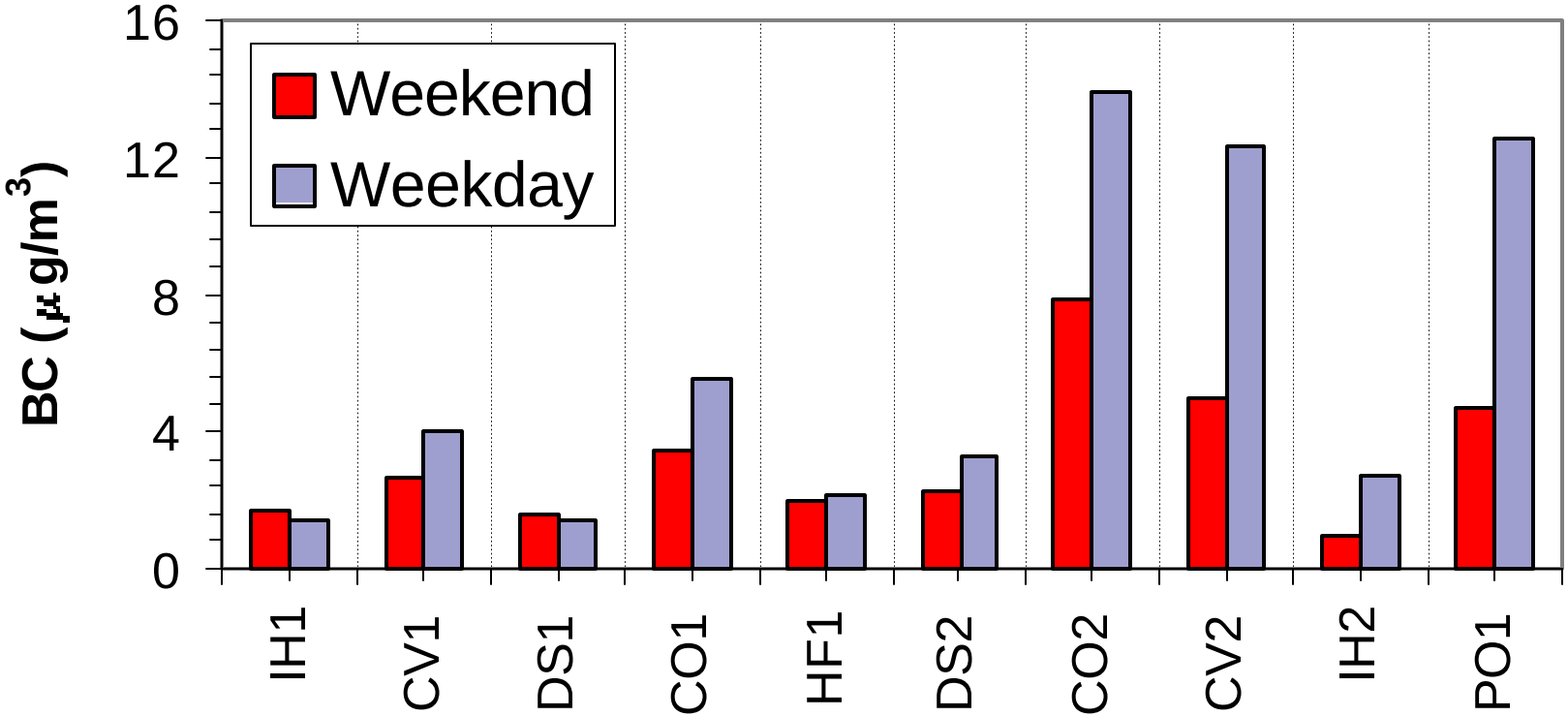
Black Carbon



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Factors Affecting the Weekend Ozone Effect

Duration of Ozone Accumulation

- Accumulation of O_3 begins about 0.5 to 0.7 hours earlier on Saturdays and about 1.1 to 1.3 hours earlier on Sundays. Since the time of maximum O_3 does not vary by day of the week, duration of ozone accumulation is greater on weekends.
- No significant changes in duration of ozone accumulation during 1981 to 1998.

Ozone Accumulation Rates

- Rates were generally higher on WDs in 1980s and higher on WEs during 1990s. Magnitude and spatial extent of the weekend effect has increased.
- Rates were higher in central basin in 1980s and higher in eastern basin in 1990s.
- Rates were cut in half during the 18-year period with largest reductions in the central basin.
- SoCAB has become more hydrocarbon limited (lower VOC/NOx).
- VOC/NOx ratios are higher on weekends.