

A Seasonal Perspective on Regional Air Quality in Central California

Presented to
CCOS Technical Committee
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Project Participants

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- LBNL: Nancy Brown, Shaheen Tonse, Xiaoling Mao
- NOAA: Jim Wilczak, Jian-Wen Bao, Sara Michelson
- CARB Emissions Group: Vernon Hughes, Klaus Scott, Cheryl Taylor
- CCOS Technical Committee

Project Objectives

- Model photochemical air pollution in Central California; 4-month period in summer 2000
- Evaluate/diagnose model performance
- Study O₃ responses to precursors:
 - Anthropogenic vs. biogenic emissions
 - NO_x vs. VOC emissions
 - Bay Area vs. Sacramento Valley vs. San Joaquin Valley
- Control strategies & inter-basin transport may differ for whole summer season vs. episodes

Approach

- Community Multiscale Air Quality (CMAQ) model
- SAPRC99 chemical mechanism
- Apply to Central Calif., summer 2000
 - Phase 1: 2-week period
 - Phase 2: 4-month period
- Use DDM-3D to quantify O₃ sensitivity to precursor emissions (Bay Area, SJV, SV)

CMAQ Modeling Domain



Phase 1 used inner purple SARMAP domain (96x117)

Phase 2 will use outer red CCOS domain (190x190)

4 km horizontal resolution

27 vertical layers; model top @ 100 mbar (~17 km)

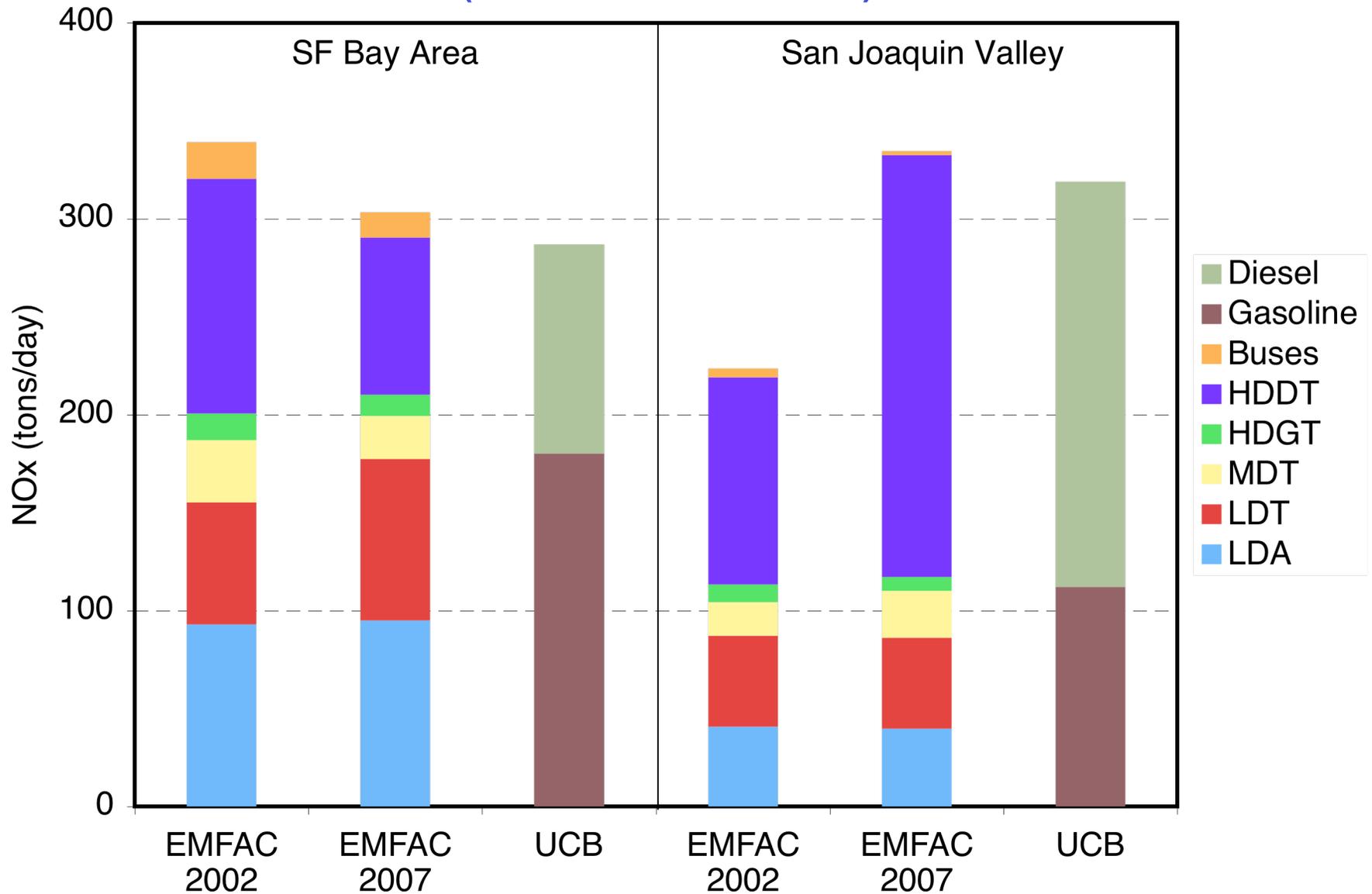
Emission Inventory Issues

- Phase 1 emissions:
 - Area, point & fire emissions from CARB
 - On-road vehicle emissions based on fuel sales, Caltrans VMT by county, weigh-in-motion traffic count data, and on-road emis data
 - Biogenic VOC estimated using BEIGIS model and observed surface temperatures and solar radiation fields (day-specific values for each day)
- On-road emissions is a scaled version of 1990 SARMAP inventory

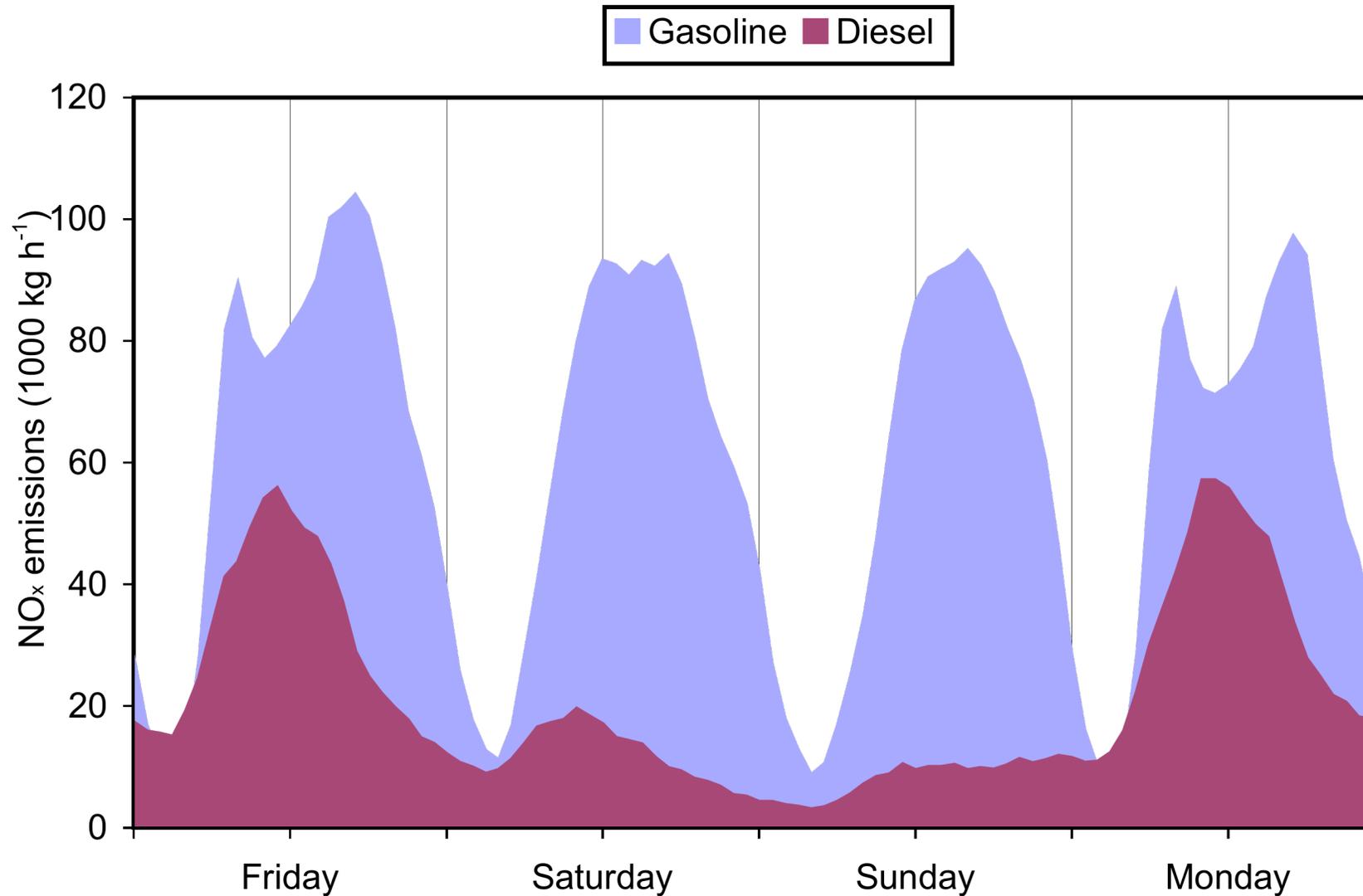
On-Road Vehicle Emissions

- Concerns about Phase 1 inventory provided by CARB in 2004:
 - Bias in HD diesel NO_x emission factor
 - Incorrect spatial allocation of HDV activity
 - Same activity patterns (diurnal, day of week) for all vehicles
- These issues addressed in revised inventory provided by CARB in 2006

On-Road NO_x Emissions (Summer 2000)

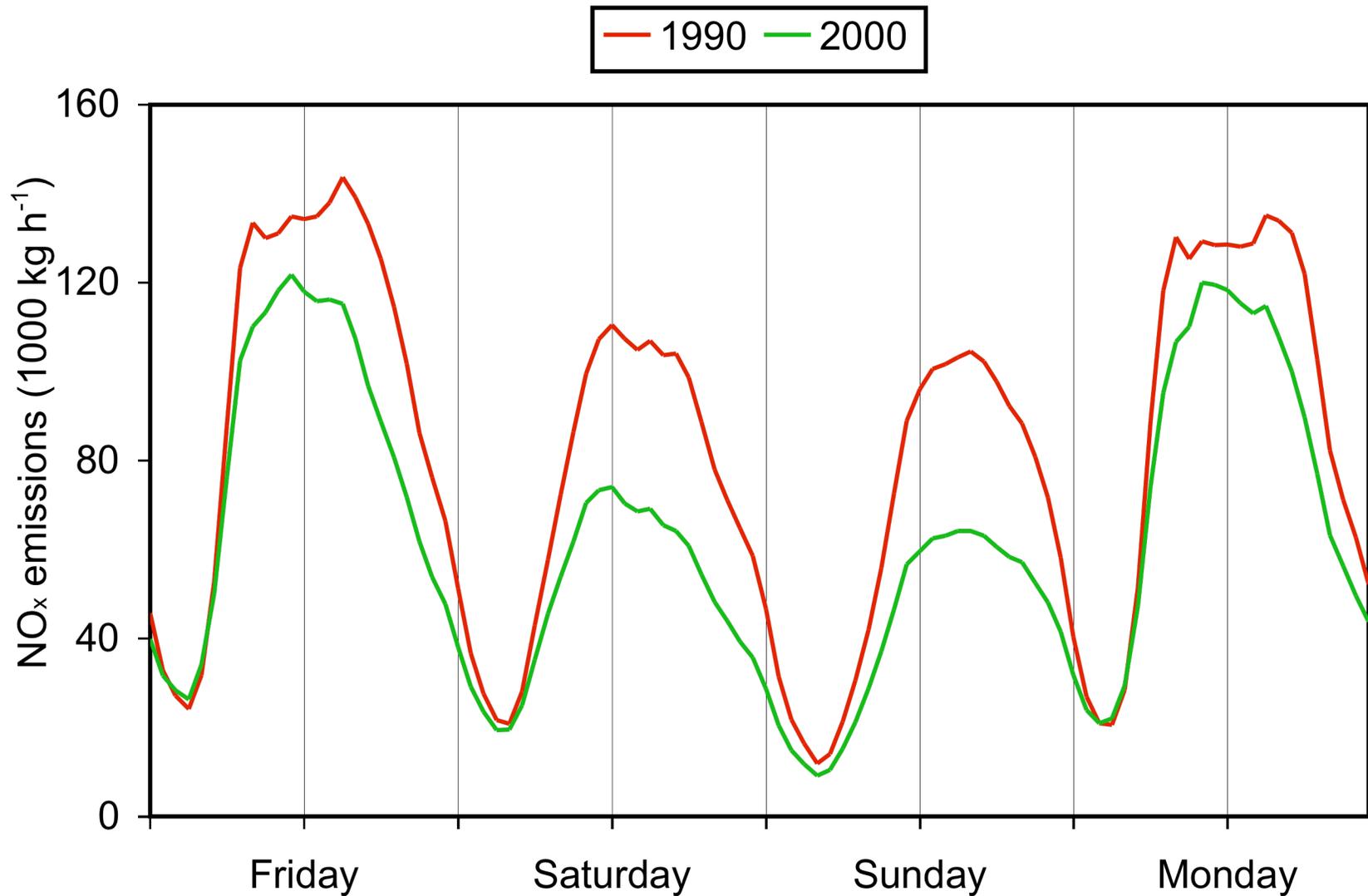


On-Road NO_x Emissions (California 1990)



Ref: Harley et al. (2005), *Environ. Sci. Technol.*

California On-Road NO_x Emissions



Ref: Harley et al. (2005), *Environ. Sci. Technol.*

Other Sources -- Discussion

- Need to define other emissions for whole summer season:
 - Day-specific biogenic VOC
 - Day-specific forest fire emissions
- There may be positive bias in off-road construction equipment emissions

Species	Western BC (ppb)	N/E/S BCs (ppb)	Clean W BC (ppb)
CO	200	200	80
NO	0.05	0.05	0.05
NO ₂	1	1	0.05
O ₃ at surface	22	40	22
O ₃ at 1km	44	48	44
O ₃ at 2km	60	60	60
HCHO	2	2	2
ALKANE-1	6	10	1
ALKANE-2	1	2.5	0.35

Additional Discussion Topics

- Shaheen Tonse:
 - Analysis of Phase 2 emission inventory estimates
 - Parallel computing improvements
- Jim Wilczak & Jian-Wen Bao:
 - Meteorological modeling and data analysis

Schedule

- Phase 1 (2-week model application):
 - Protocol document revised 8/06
 - Revised final report 12/06
- Phase 2 (4-month model application):
 - Complete met & emissions modeling (3/07)
 - Conduct air quality modeling (6/07)
 - Met/AQ model performance & data analysis (9/07)
 - Sensitivity analysis to precursor emissions (12/07)
 - Draft final report (3/08)