Comparison of Wintertime CO to NOx Ratios to MOVES and MOBILE6.2 On-Road Emissions Inventories

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Treasure Valley PM2.5 Precursor Study

The Idaho Department of Environmental Quality (IDEQ) funded WSU to measure at the Idaho DEQ site in Meridian, Id. From December 1, 2008 through January 31, 2009.

Instrumentation

Meteorology

P, T, RH, Wind speed & direction, Precip (Vaisala WXT)

Boundary Layer Height (Leosphere Aerosol Lidar)

Trace Gases

Ozone (Dasibi)

Carbon Monoxide (Aerolaser)

NO_x / NO_y (Air Quality Design)

Time Resolved VOCs (PTR-MS, Ionicon)

Aerosol

Particle Size Distribution

- nano SMPS (3-60 nm) (Assembled in house with TSI components)
- long SMPS (40-700nm) (Assembled in house with TSI components)
- APS (0.6-20 um) (TSI)

Bulk Soluble Composition

- Particle-Into-Liquid Sampler (Brechtel)
- Inorganics (SO_4, NO_3, Cl, NH_4, Na, Mg, ...) by Ion Chromatography (Metrohm-Peak)
- Water soluble organic carbon by TOC analysis (Sievers / GE Analytical)

Cloud Condensation Nuclei (DMT)

Aerosol Spatial Variability and Optical Depth (Leosphere Aerosol Lidar)

Parrish, D.D., Atmospheric Environment 2006

•Comparison of the trend of measured ratio of CO to NOx to the national emissions inventories (NEI).

•The emission ratio is a moving target and that it was not well captured by all of the emissions inventories.

•The decrease in the CO to NO_x ratio is due to updated pollution controls in the fleet and increase reliance on diesel.

•Concluded that CO is overestimated by MOBILE6 by a factor of 2.

•Based on summertime data! What about the winter?

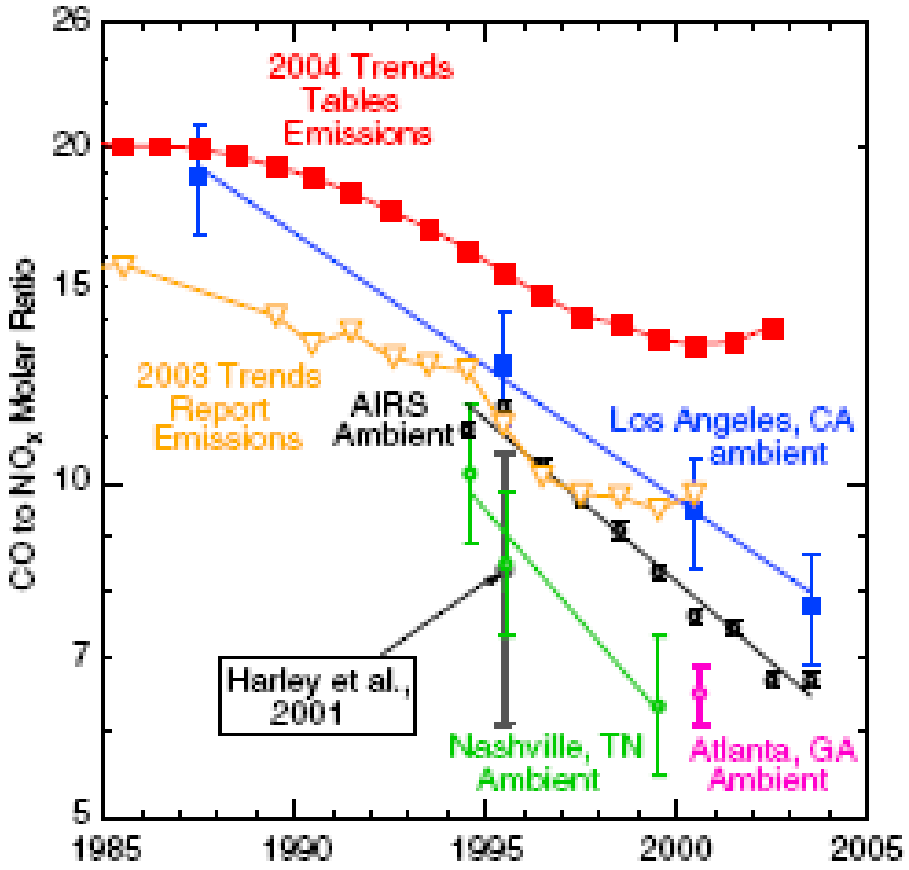
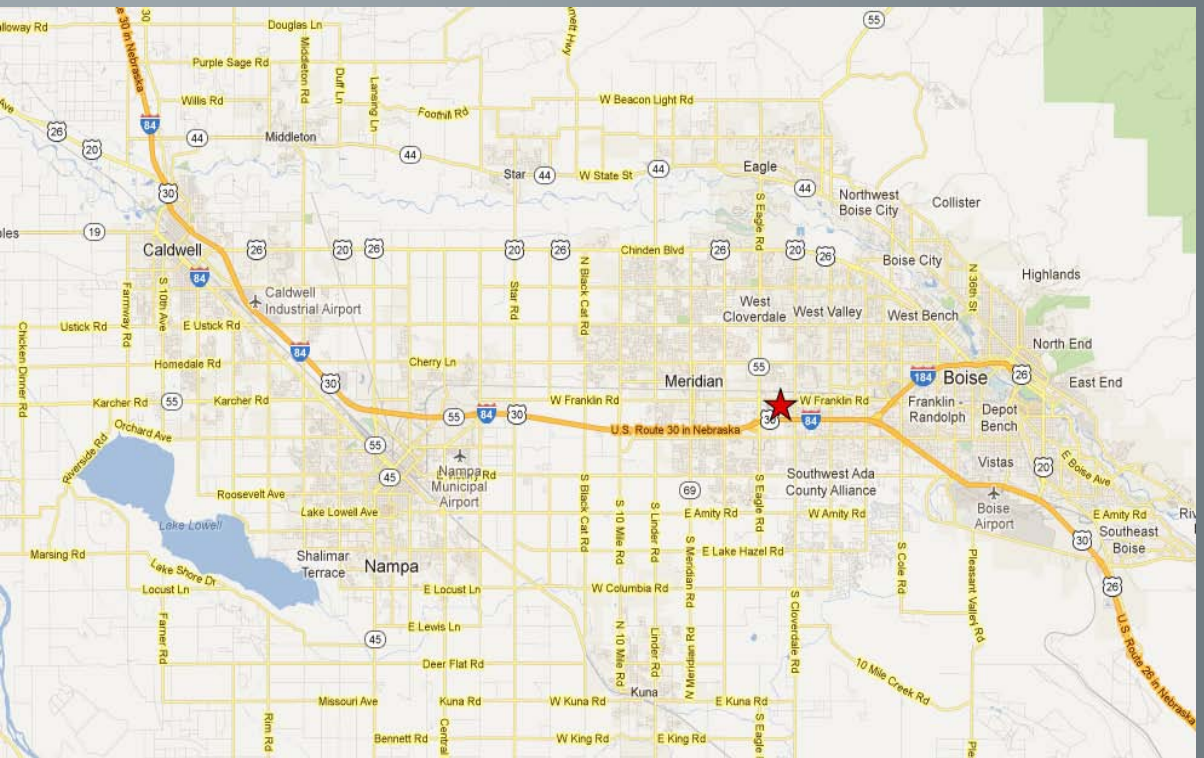
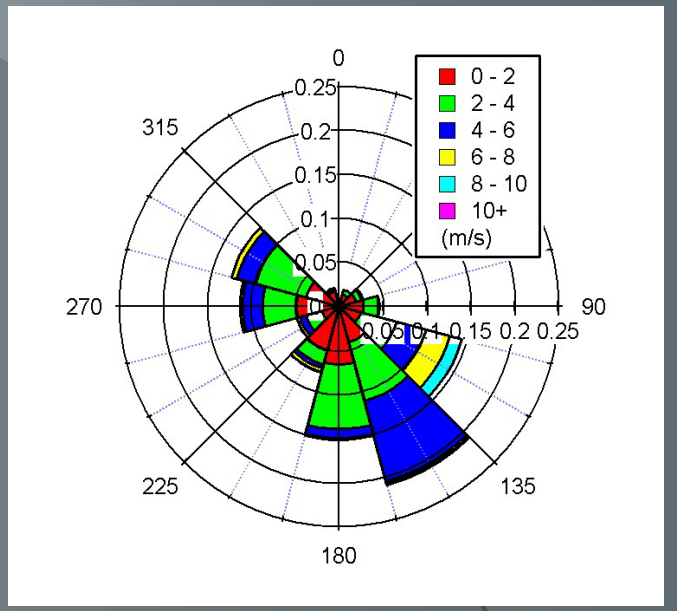


Fig. 3. Semi-log plot of temporal trends of observed urban ambient CO to NO_x ratios compared to ratios from on-road vehicle emission estimates.

The Site

The site was subjected to winds from the southeast and northwest.





S. Eagle Road
~300m West

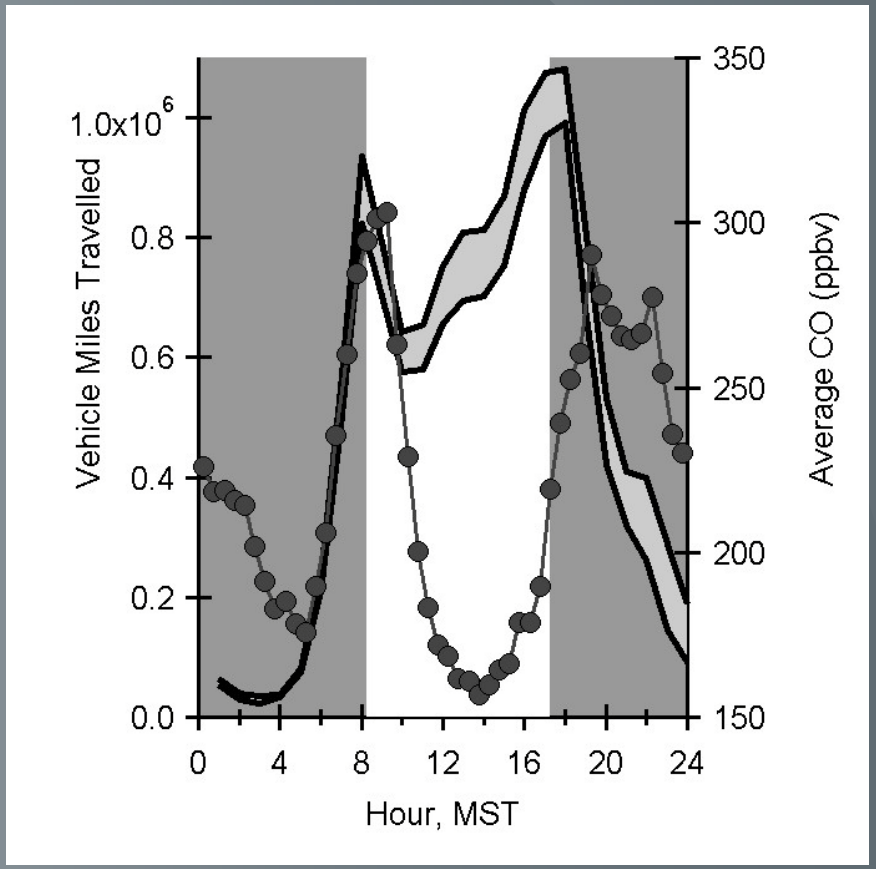
I-84
~300m South

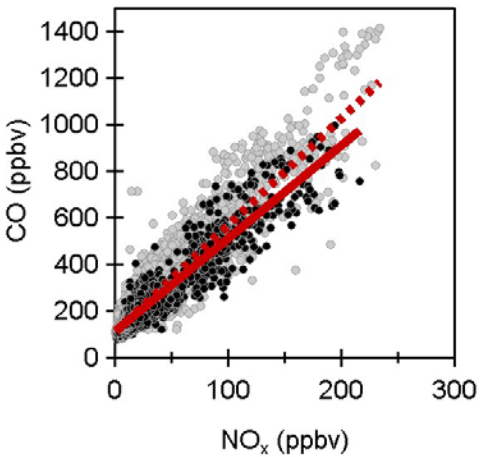
VMT and Pollutants

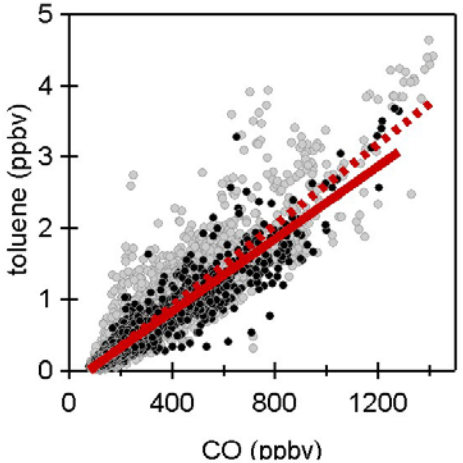
Most of the morning rush hour occurs before sunrise.

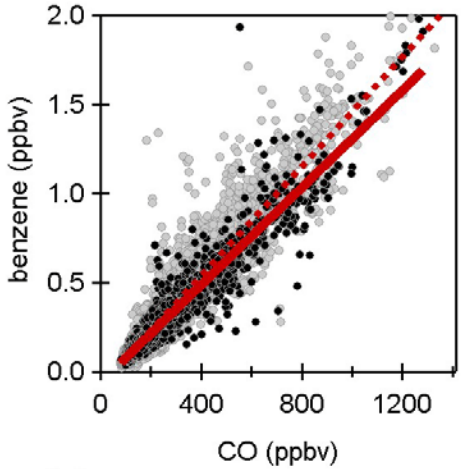
Low mixing heights

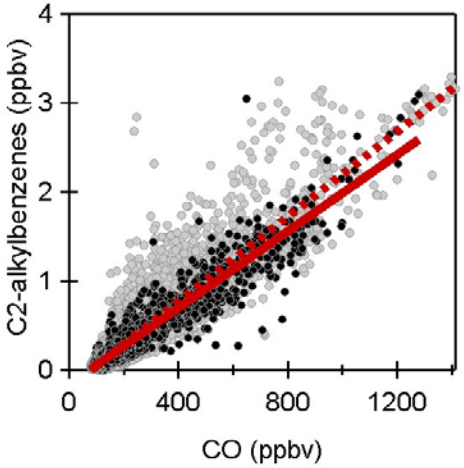
Increase in VMT drives increase in pollutant ratios.

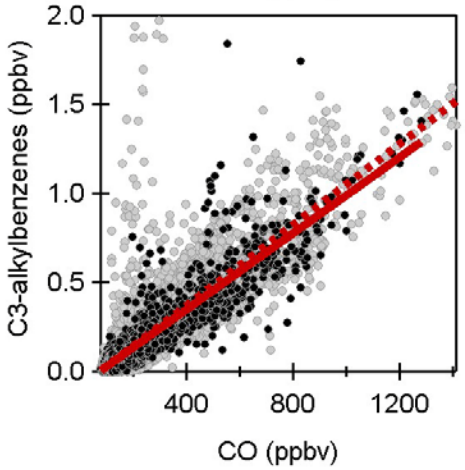












The Ratios

- ΔCO >300 ppbv.
- Very little difference between the selected periods, rush hour and all data.

	CO/NOx	benzene/CO	Toluene/CO	C2-alkylbenz
Selected	4.2	1.3	2.4	2.3
All RH	4.1	1.4	2.6	2.2
All Data	4.6	1.5	2.8	2.4

Diel Ratios

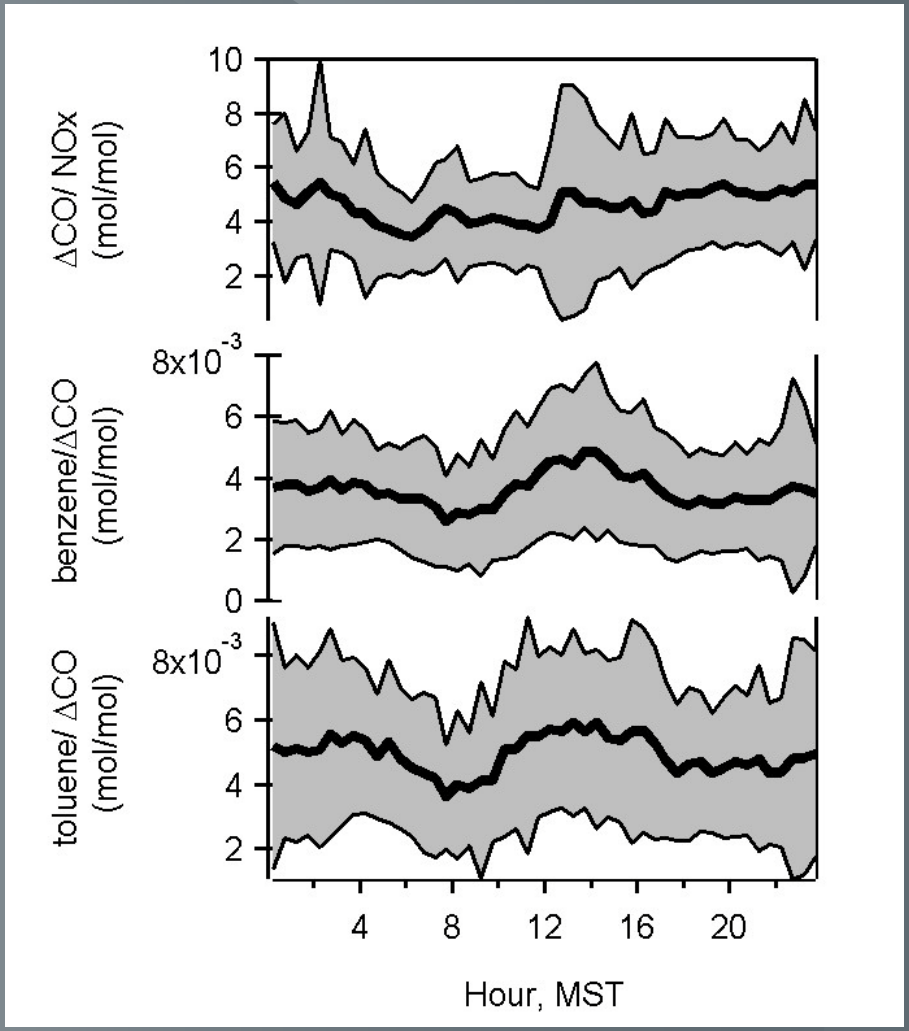
•ΔCO denotes CO background removed

•Not a precise determination of the ratio but shows trends.

•VOC to ΔCO ratios show an increase during the day. Presumably temperature driven.

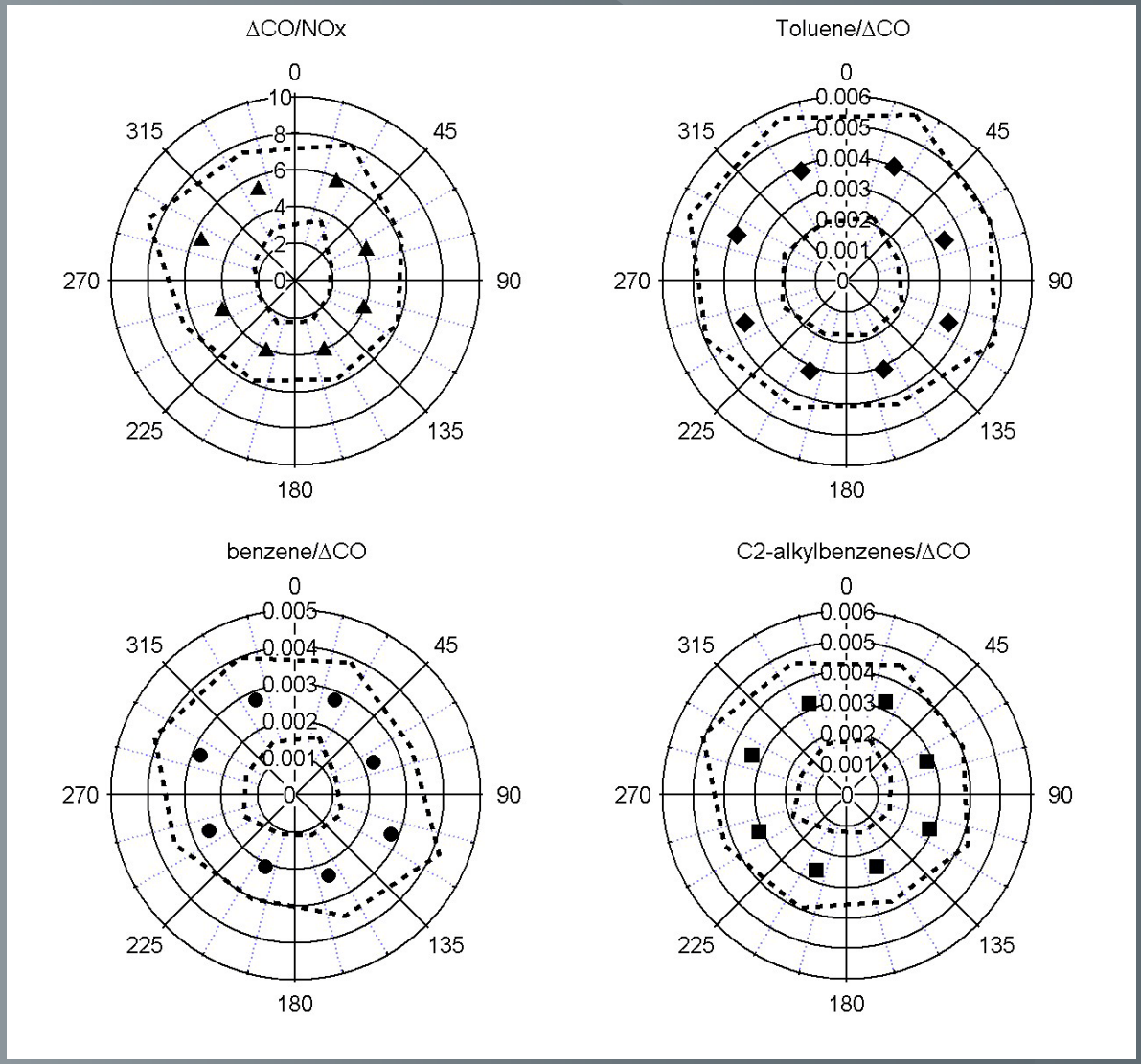
•ΔCO to NOx lowest during morning rush hour?

•No statistically significant changes in the ratio through out the day

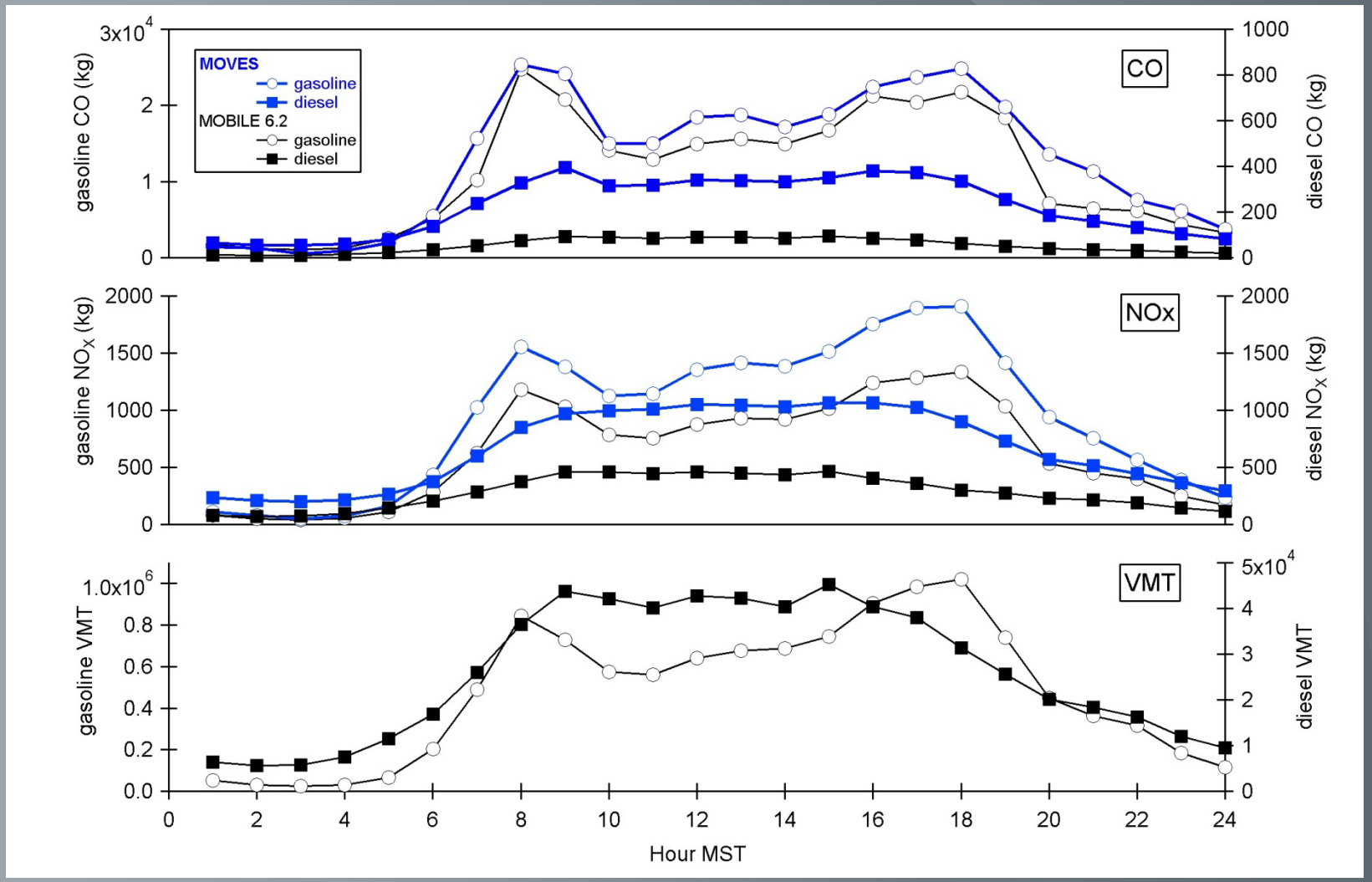


Directional variation in the ratio

- Observed small directionality in the ratios.
- Statistically insignificant.
- Site impacted by on road component.



MOVES vs MOBILE6



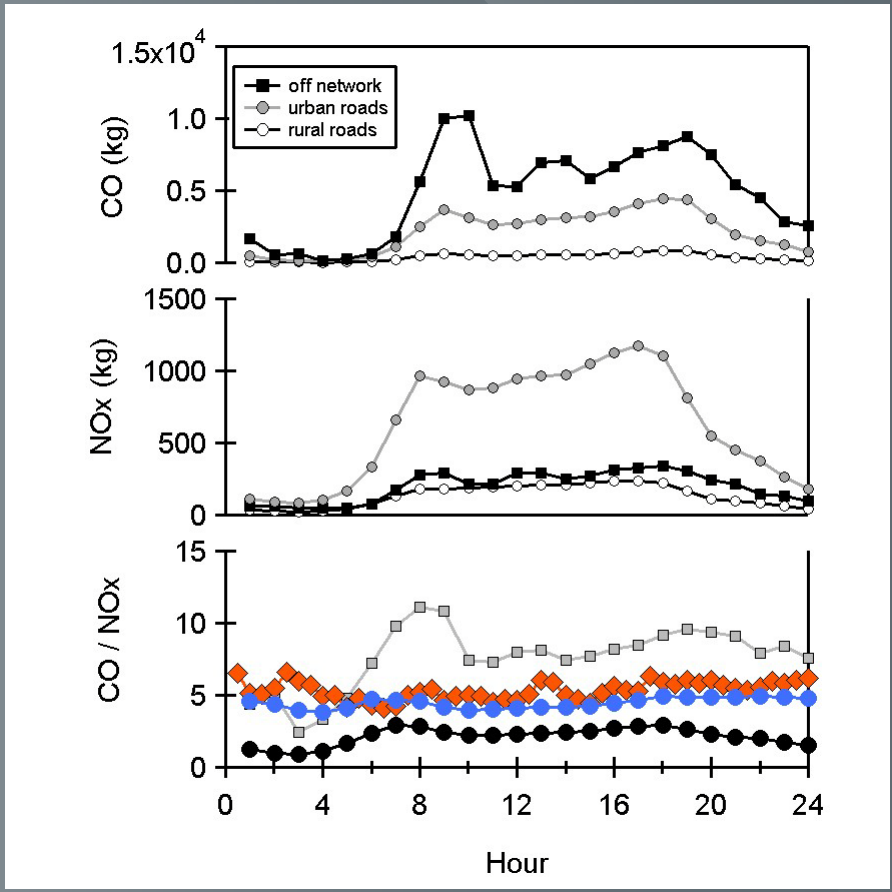
MOVES and observations

CO:
Urban roads 29.2%
Rural roads 5.3%
Off network 65.5%

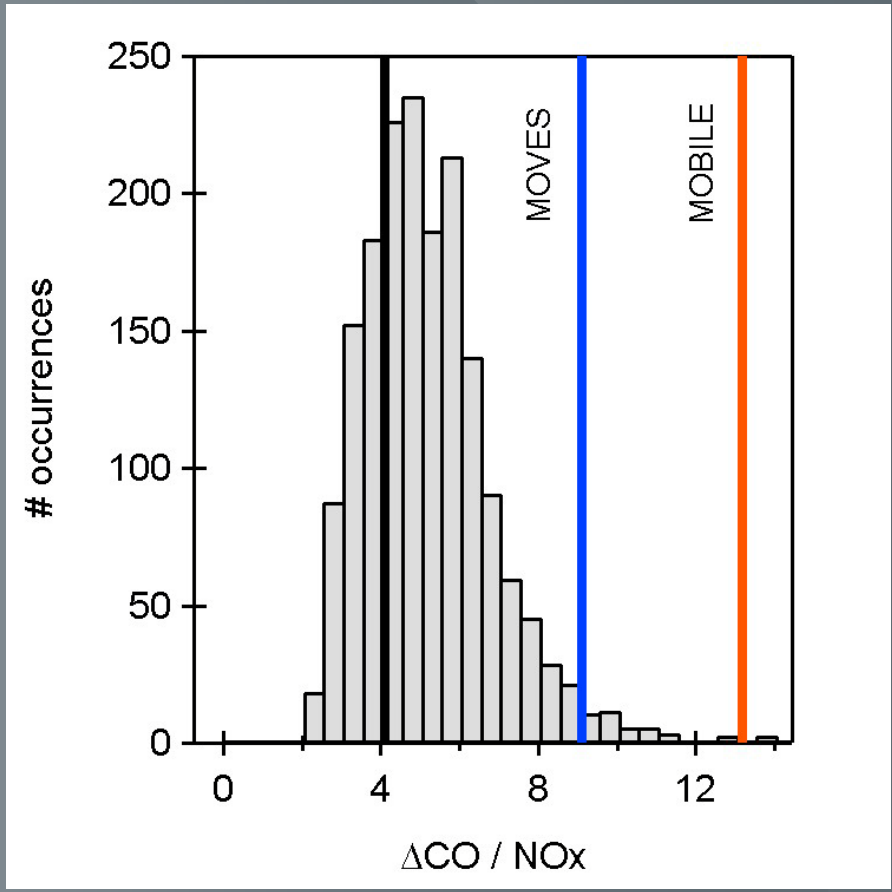
NOx:
Urban roads: 65.7%
Rural roads: 13.8%
Off Network: 20.5

MOVES urban roads CO-to-NOx ratios agree to within 20% of observations.

Impact of off network emissions not observed.



- MOBILE includes all emissions (on road, and off network.)
- MOBILE6 includes off network emissions
- MOBILE6 is not supported by observations.
- MOVES does a better job of predicting CO-to-NO_x than MOBILE6



Conclusions

•Wintertime provides excellent conditions to measure emissions from the mobile fleet.

•Site was impacted by urban on road emissions.

•Off network emissions were not observed. They remain unevaluated by this study. Future work should evaluate off network emissions.

•Wintertime off network emissions are very important to the inventory (65% CO, 20% NOx).

•MOVES CO-to-NOx agrees to with in 20% of the observations when comparing the urban on road component. This is EXCELLENT!

•Disaggregation of the emissions in MOVES is of great value to the atmospheric community.

Acknowledgements

IDEQ

NSF

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Questions?