

MOVES-Based NO_x Analyses for Urban Case Studies in Texas

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Sonoma Technology, Inc.

How do we reconcile mobile NO_x emissions?

Monitored

Emitted



Modeled
(Inventory)

Research Questions

1. *Does MOVES overestimate NO_x emissions?*

Emissions reconciliation analysis

Compare near-road monitoring data to output from MOVES to examine NO_x emissions estimates

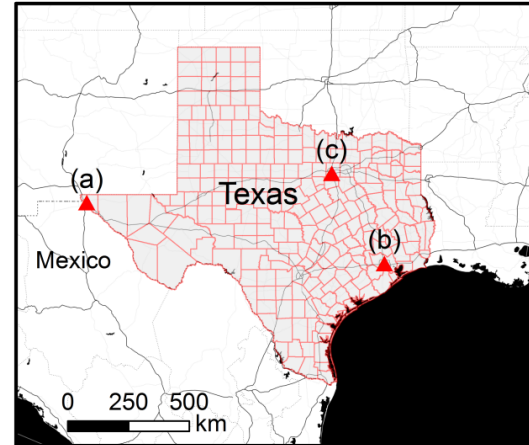
2. *What MOVES input data are important for NO_x emissions estimates?*

Emissions sensitivity analysis

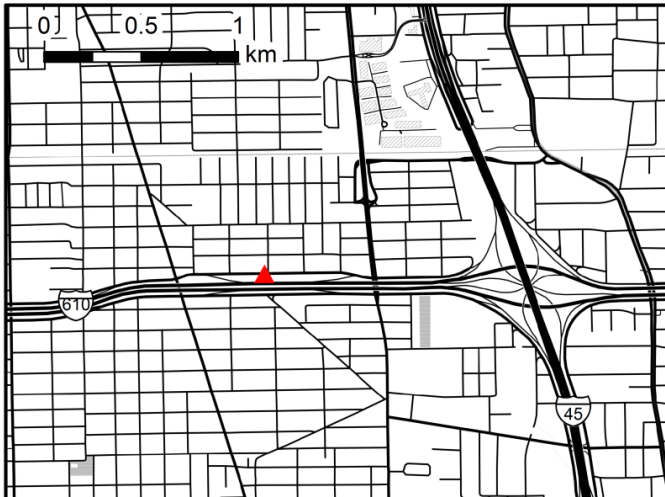
Identify input parameters that have larger influence on MOVES-based NO_x emissions

Case Study Settings

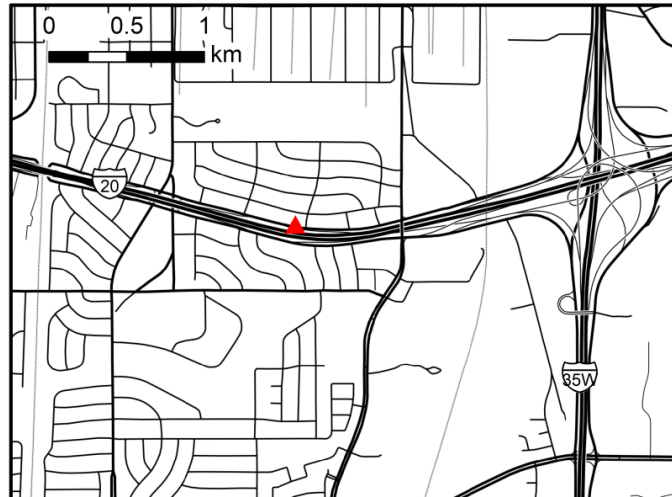
(a) El Paso (EP)



(b) Houston (HT)



(c) Fort Worth (FW)



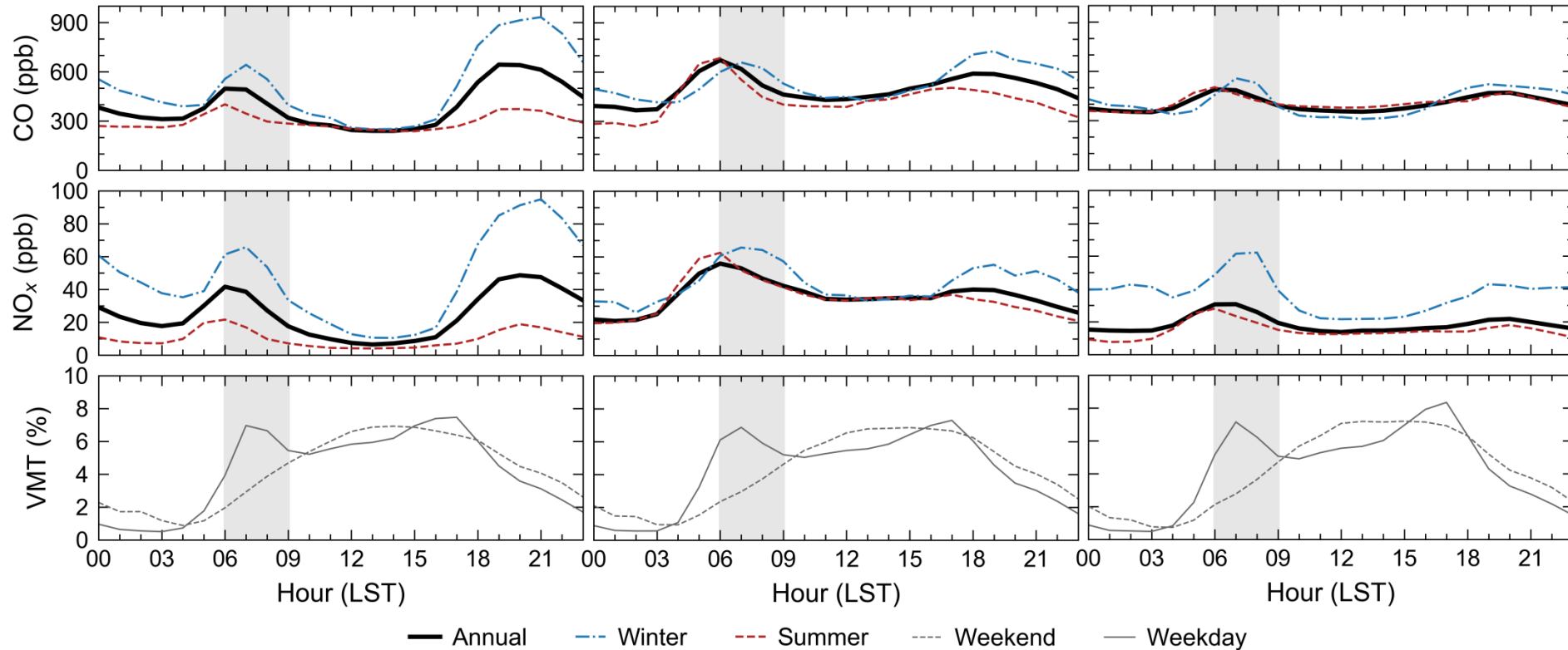
Ambient Data

2015

(a) EP

(b) HT

(c) FW



✓ Near road

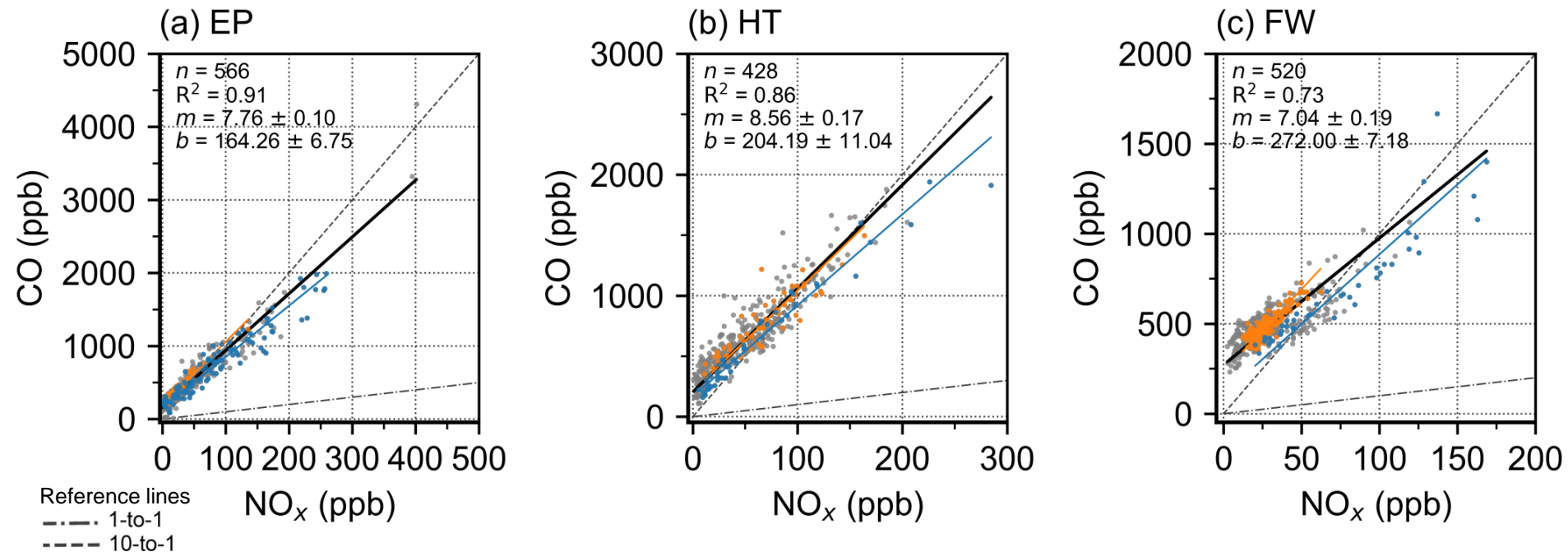
✓ 06:00 – 09:00

✓ Monitor
downwind

✓ CO/NO_x ratios

Ambient CO/NO_x Ratios

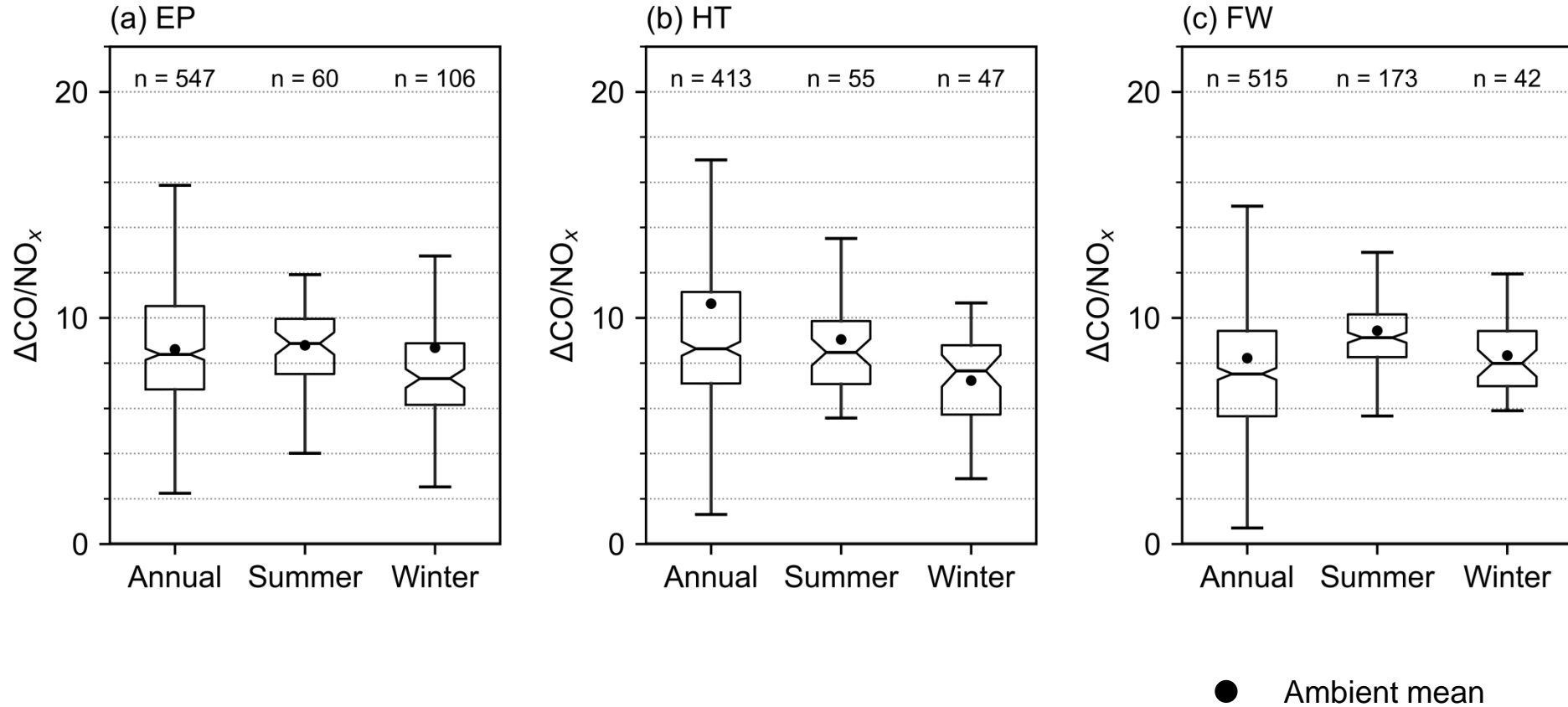
2015



Total linear least-squares regression

Annual, **Summer** (Jun-Aug), **Winter** (Dec-Feb)

Comparison of CO/NO_x Ratios



MOVES Modeling



Section	Setting
Scale	
<i>Domain/Scale</i>	County
<i>Calculation Type</i>	Inventory
Time Span	
<i>Aggregation Level</i>	Hour
<i>Year</i>	2015
<i>Months</i>	All
<i>Days</i>	Weekend, Weekday
<i>Hours</i>	Start Hour: 6, End Hour: 9
Geographic Bounds	Texas Counties: El Paso, Harris, Tarrant
Vehicles/Equipment	All
Road Type	Urban restricted-access roads
Pollutants and Processes	
<i>Processes</i>	Running Exhaust, Crankcase Running Exhaust
<i>Species</i>	CO, NO, NO ₂

MOVES Modeling

Default scenario:

MOVES2014a national default inputs

Best Available Local (BAL) scenario:

MOVES county databases (CDBs) from TCEQ, HGAC, NCTCOG
Local activity data from TxDOT Roadway Inventory

The screenshot displays the MOVES software interface. The main window shows a list of input categories on the left, including Description, Scale, Time Spans, Geographic Bounds, Vehicles/Equipment, Road Type, Pollutants And Processes, Manage Input Data Sets, Strategies, and Output. The main area shows a list of states with 'Texas - Harris County' selected. A 'MOVES County Data Manager' dialog box is open in the foreground, showing a grid of checked input categories: Vehicle Type VMT, Hotelling, I/M Programs, Retrofit Data, Generic, Tools, Ramp Fraction, Road Type Distribution, Source Type Population, Starts, RunSpec Summary, Database, Age Distribution, Average Speed Distribution, Fuel (unchecked), and Meteorology Data. The dialog box contains fields for Server (localhost), Database (c48201_hgac_tceq_pk_2015_ann_in), and Log. A list of log entries is visible at the bottom of the dialog box.

MOVES - T:\ProjectDocs\916046 UT-Austin AQRP MOVES NOx Analysis\Task 1 Emissions Reconciliation Analysis\data\MOVES\mrs\C48201_HGAC_TCEQ_PK_2015EL_Ann.mrs - I...

File Edit Pre Processing Action Post Processing Tools Settings Help

Region: States: Counties: Selections:

Nation
 State
 County
 Zone & Link
 Custom Domain

ALABAMA
ALASKA
ARIZONA
ARKANSAS
CALIFORNIA
CONNECTICUT
COLORADO
DELAWARE
DISTRICT OF COL

Domain Input Data
The County domain
Server: localhost
Database: c48201

Geographic Bounds Requirements

Open an existing RunSpec

MOVES County Data Manager

Vehicle Type VMT Hotelling I/M Programs Retrofit Data Generic Tools

Ramp Fraction Road Type Distribution Source Type Population Starts

RunSpec Summary Database Age Distribution Average Speed Distribution Fuel Meteorology Data

Select or create a database to hold the imported data.

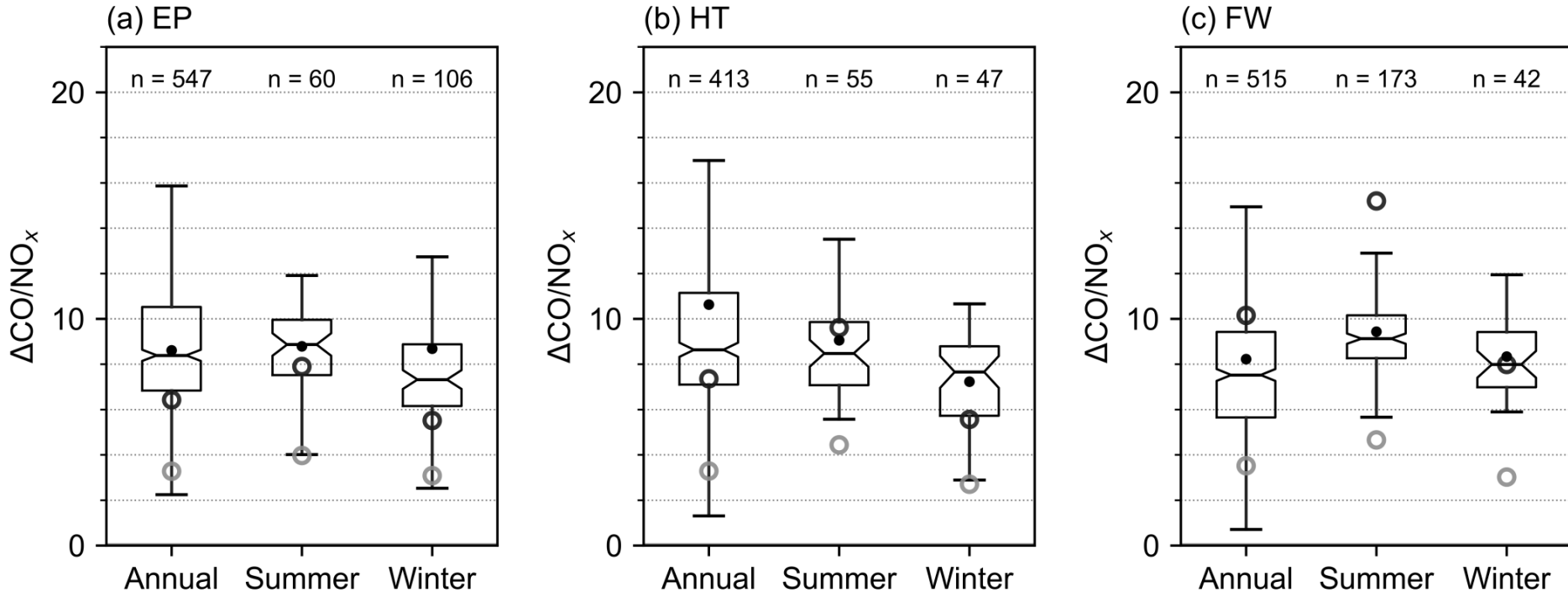
Server: localhost Refresh

Database: c48201_hgac_tceq_pk_2015_ann_in Create Database

Log: Clear All Imported Data

2017-05-15 18:24:05.0 Vehicle Type VMT Filled HPMSVTypeYear table
2017-03-08 17:48:04.0 Fuel Filled FuelUsageFraction table
2017-03-08 17:48:04.0 Fuel Filled avft table
2017-03-08 17:08:45.0 Age Distribution Filled SourceTypeAgeDistribution table
2017-03-08 17:06:57.0 I/M Programs Filled IMCoverage table

Comparison of CO/NO_x Ratios



- CO/NO_x ratios based on MOVES Default are much lower than ambient-based ratios
- MOVES-based ratios using BAL inputs and ambient-based ratios are in good agreement

- Ambient mean
- MOVES Default
- MOVES BAL

Reconciliation Analysis: Findings

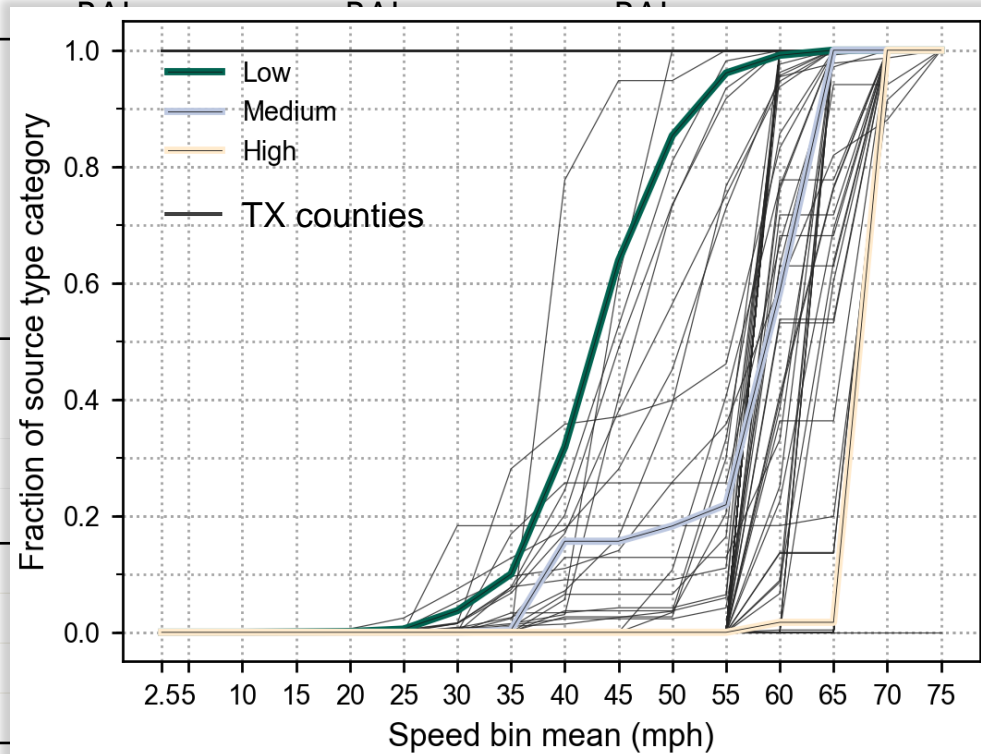
- MOVES emissions for CO or NO_x or both pollutants based on **Default** inputs did not reasonably represent on-road mobile sources
- MOVES emission ratios using **BAL** inputs are comparable with the respective ambient ratios (within the acceptable 25-50% range of agreement)
- Using BAL inputs is key to generate reasonable emissions estimates

Emissions Sensitivity Analysis

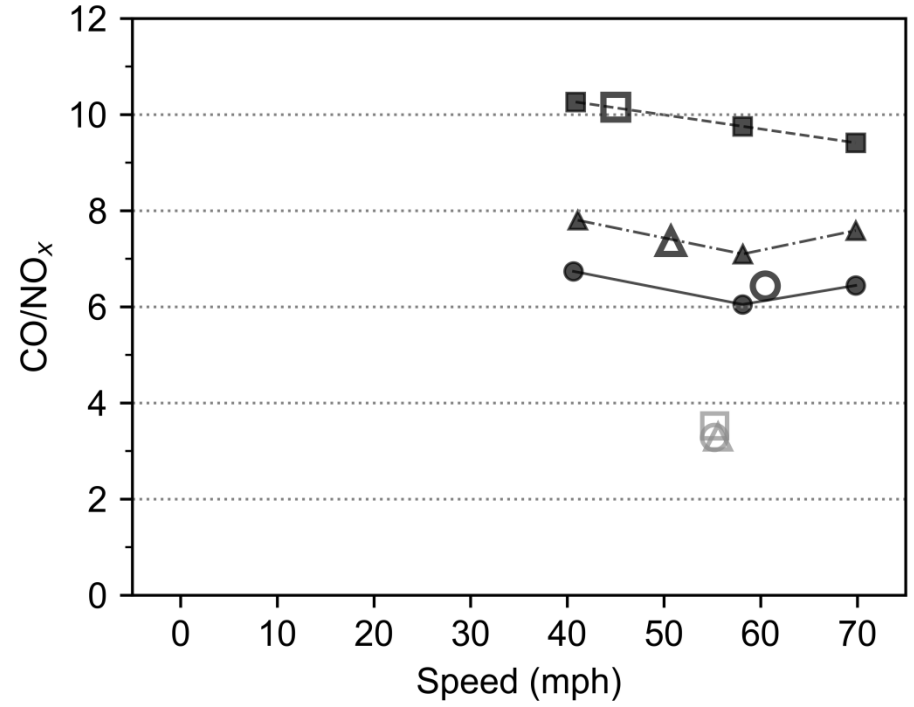
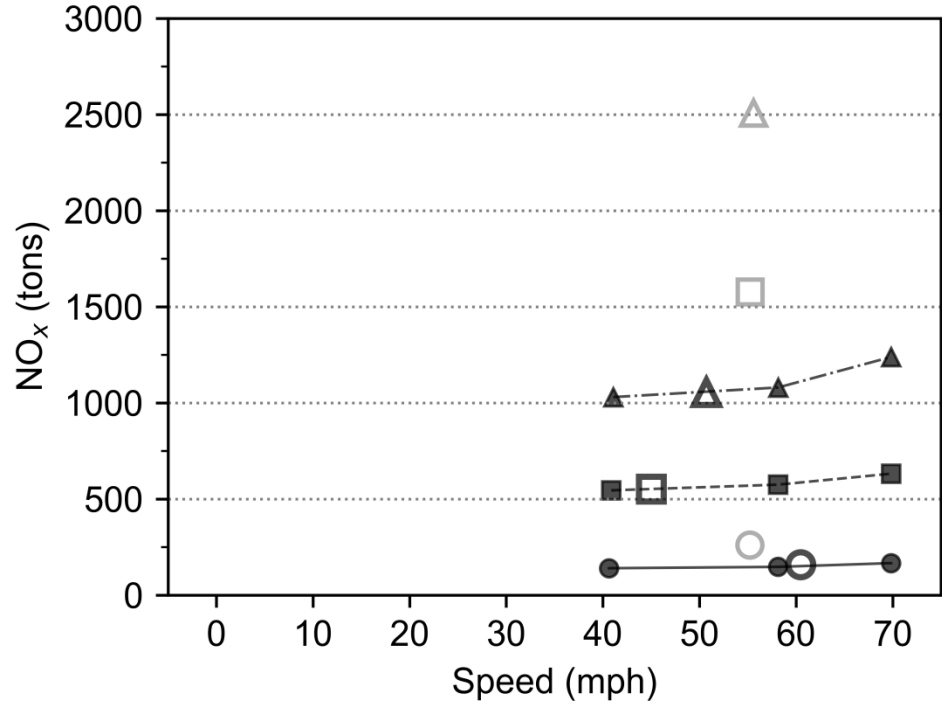
	Scenario	Speed Distribution	Truck %	Age Distribution	Temperature and RH
	Base	BAL	BAL	BAL	BAL
Speed	Speed Base-Default	Default	BAL	BAL	BAL
	Speed Low	Low	BAL	BAL	BAL
	Speed Medium	Medium	BAL	BAL	BAL
	Speed High	High	BAL	BAL	BAL
Fleet Mix	Truck Base-Default	BAL	Default	BAL	BAL
	Truck 0	BAL	0	BAL	BAL
	Truck 5	BAL	5	BAL	BAL
	Truck 10	BAL	10	BAL	BAL
	Truck 20	BAL	20	BAL	BAL
	Truck 30	BAL	30	BAL	BAL
Age	Age Base-Default	BAL	BAL	Default	BAL
	Age Old	BAL	BAL	Old	BAL
	Age Mid	BAL	BAL	Mid	BAL
	Age New	BAL	BAL	New	BAL
Met.	Season Base-Default	BAL	BAL	BAL	Default
	Season Half	BAL	BAL	BAL	6 month mean
	Season Quarter	BAL	BAL	BAL	3 month mean
	Season Month	BAL	BAL	BAL	1 month mean

Emissions Sensitivity Analysis

	Scenario	Speed Distribution	Truck %	Age Distribution	Temperature and RH
	Base	BAL	BAL	BAL	BAL
Speed	Speed Base-Default	Default	BAL	BAL	BAL
	Speed Low	Low	BAL	BAL	BAL
	Speed Medium	Medium	BAL	BAL	BAL
	Speed High	High	BAL	BAL	BAL
Fleet Mix	Truck Base-Default	BAL			
	Truck 0	BAL			
	Truck 5	BAL			
	Truck 10	BAL			
	Truck 20	BAL			
	Truck 30	BAL			
Age	Age Base-Default	BAL			
	Age Old	BAL			
	Age Mid	BAL			
	Age New	BAL			
Met.	Season Base-Default	BAL			
	Season Half	BAL			
	Season Quarter	BAL			
	Season Month	BAL			

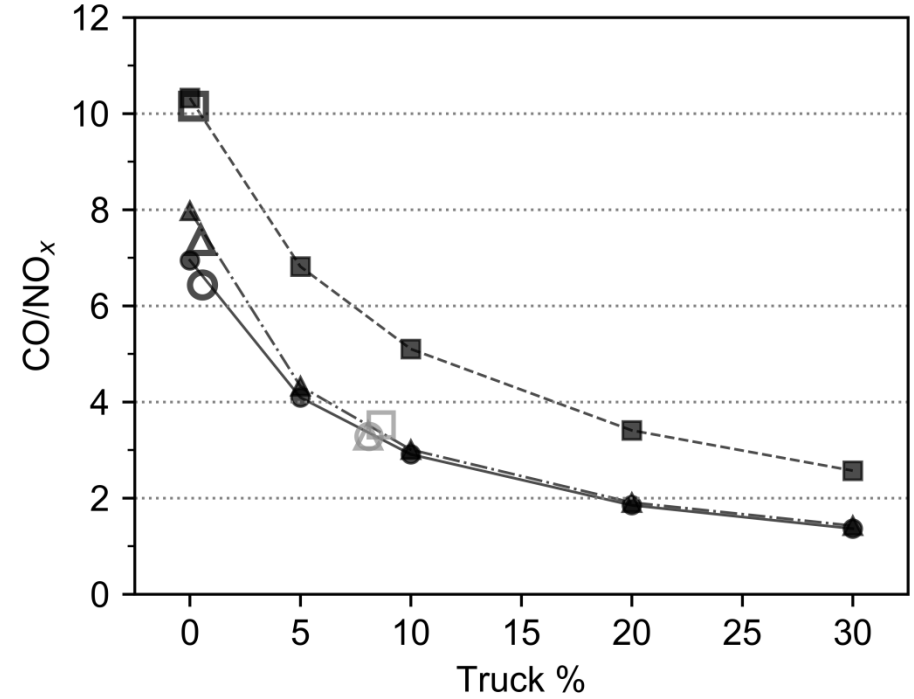
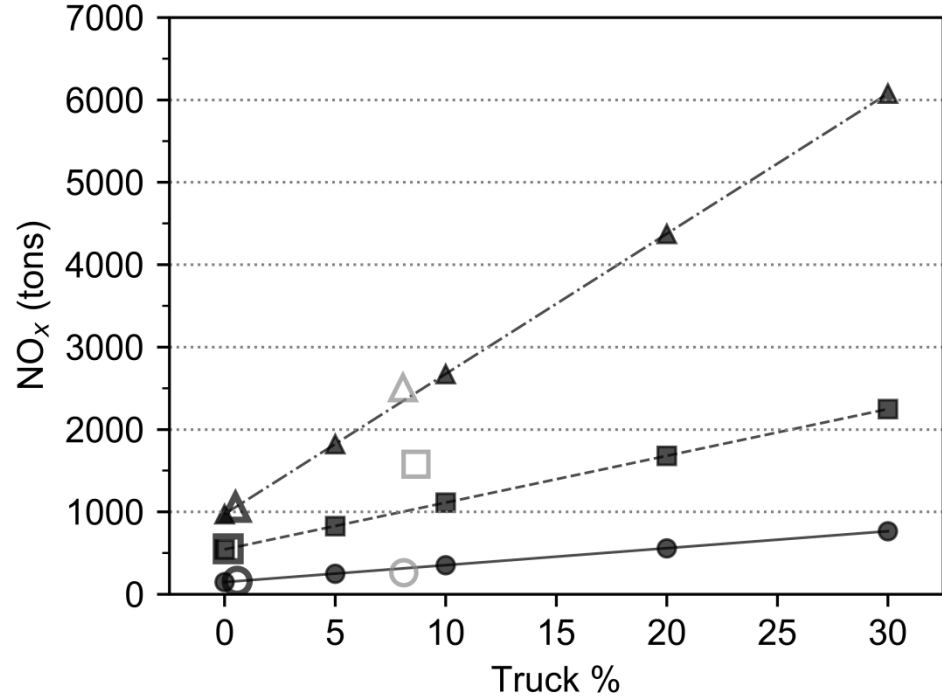


Sensitivity: Speed



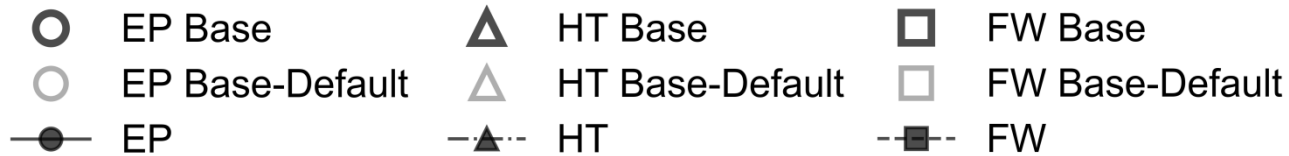
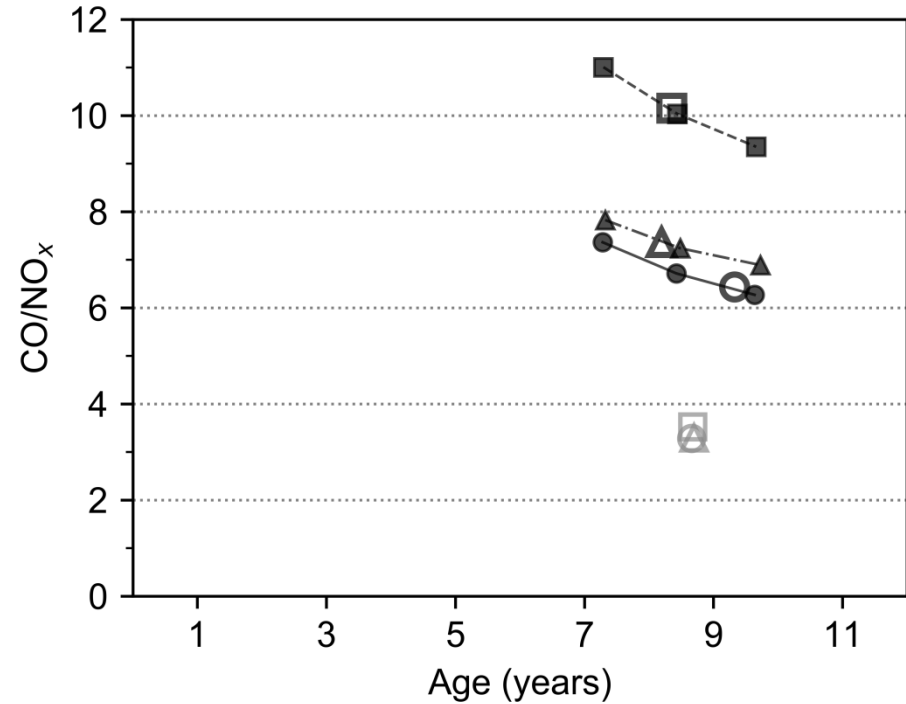
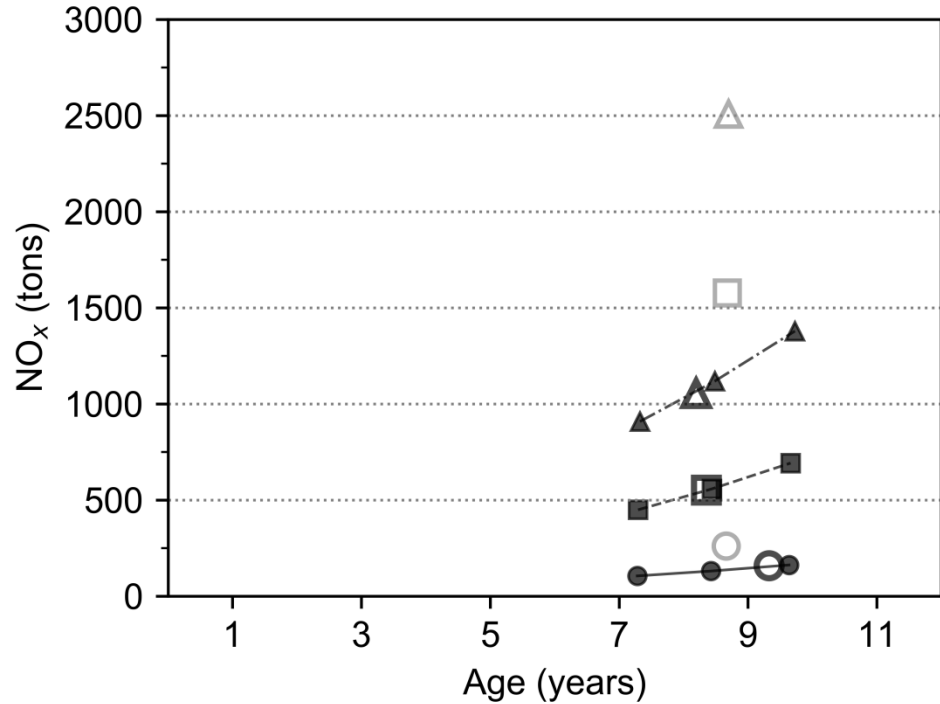
- EP Base
- △ HT Base
- FW Base
- EP Base-Default
- △ HT Base-Default
- FW Base-Default
- EP
- △- HT
- FW

Sensitivity: Fleet Mix

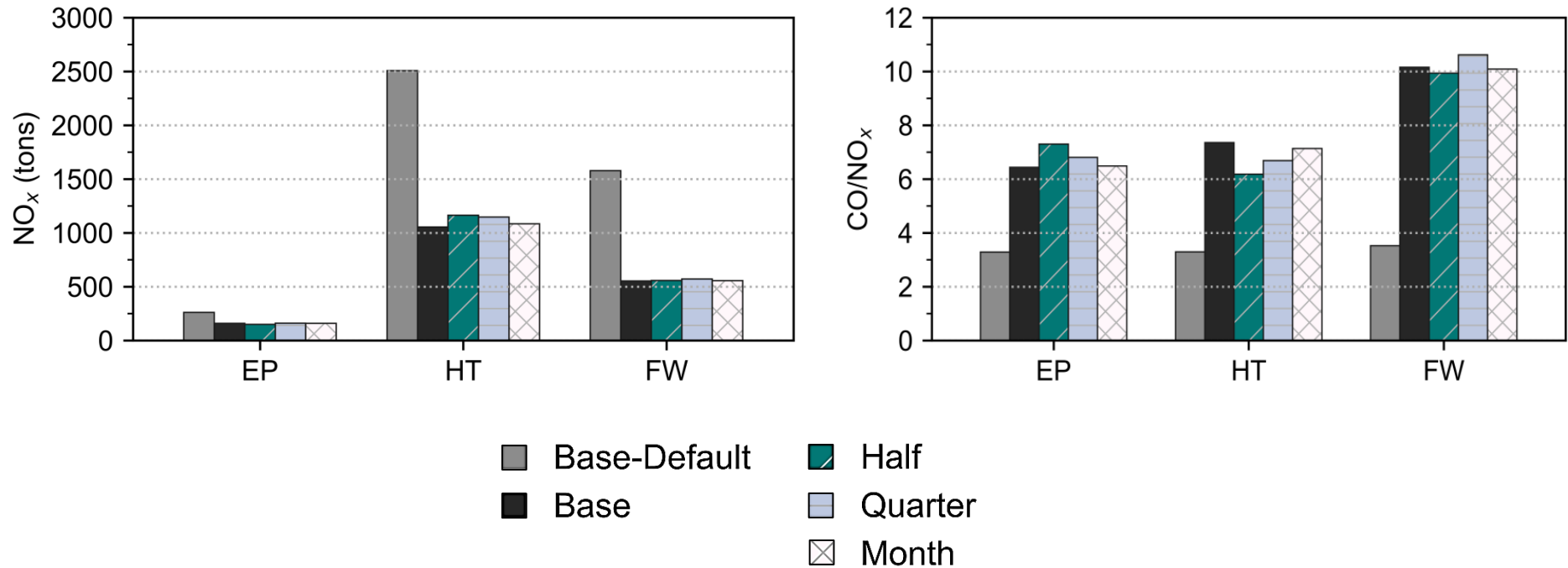


- EP Base
- △ HT Base
- FW Base
- EP Base-Default
- △ HT Base-Default
- FW Base-Default
- EP
- △- HT
- FW

Sensitivity: Age



Sensitivity: Meteorology



Sensitivity Analysis: Findings

- NO_x running exhaust emissions estimates are more sensitive to fleet mix and vehicle age distribution
- Data collection priority should be on fleet characteristics

Conclusions

1. *Does MOVES overestimate NO_x emissions?*
 - MOVES Default inputs can generate biased ratios and lead to incorrect emissions assessment
 - Using local (BAL) input data, MOVES emissions-based ratios are comparable to ambient-based ratios—no substantial over-estimation was found
2. *What MOVES input data are important for NO_x emissions estimates?*
 - Priority for local data collection and quality assurance should be given to parameters that emissions are more sensitive to, e.g., truck percentage and vehicle age distribution.

Acknowledgments

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Questions?

