

Use of travel demand modeling in state emission inventories

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LADCO Emissions Activities

- Build Emissions Inventories to support regional analysis.
- Primarily used as input to chemical transport model
- Inventory must reflect real days that are modeled.
- Includes: Electric Utilities, Industrial Point, Onroad Mobile, Offroad Mobile, Agriculture, Solvents and Fuel Combustion, Biogenics

CONCEPT MV

- Uses output from transportation demand models (TDM)
- Generates gridded, hourly link-level emissions by vehicle class
- Uses 8 MOBILE5 vehicle classes
- Uses trip data to estimate starts and hot soaks
- Detailed temporal resolution of traffic volume, speeds, and VMT mix
- Uses gridded met data
- Stores many intermediate emissions tables for QA and data review

TDM Transformation Tool (T3) CONCEPT MV Pre-processor

- Needed for processing output from a variety of Transportation Demand Models
- Generates RPO Data Exchange Protocol Format
 - Network Definition, Link Coordinates
 - Activity Data (VMT, Speeds, Trip Starts/Ends)
 - Speed Adjustment Instructions
 - Similar to NEI

TDM Inputs to T3

- Link Characteristics
 - Endpoint coordinates and projection definition
 - Link volumes
 - Link capacities
 - Link lengths
 - Link speeds or free flow speeds
 - Link facility class
- Vehicle Trip Starts and Ends by Traffic Analysis Zone (TAZ)

Volume Data

- Daily Average or Intra-Day Periods
 - Off-peak, morning peak, mid-day, pm peak
 - Partial hours (e.g., 7:30am to 9:15am)
 - Overnight (e.g., 9:00pm to 6:00am)
- All Vehicles or by TDM Vehicle Class
 - T3 passes through vehicle class details
 - CONCEPT converts to eight MOBILE5 vehicle classes

Speed Data

- TDMs rarely output calculated speeds
- Generally have free flow speeds
- TDMs adjust free flow speeds
 - Volume/capacity ratio
 - Queuing algorithm
- Adjustment must be done hourly (i.e., after temporal allocation)
- T3 passes speed adjustment instructions to CONCEPT

T3/CONCEPT Speed Adjustments

- Three Options
 - Volume-delay function (BPR curve)
 - Lookup tables by speed and volume/capacity ratio
 - Directly input post-processed speeds
- BPR curves and lookup tables require capacities, free flow speeds, and hourly volumes
- CONCEPT generates hourly volumes using temporal profiles

T3/CONCEPT Speed

Adjustments

Most common adjustment is BPR curve:

$$S_a = \frac{S_{ff}}{1 + \left[A * \left(\frac{V}{C} \right)^B \right]}$$

S_a	=	actual link speed (mph)
S_{ff}	=	reported link free flow speed (mph)
V	=	total link volume (vehicles OR vehicles per hour)
C	=	total link capacity (vehicles OR vehicles per hour)
A, B	=	curve calibration coefficients

Additional Options

- Volume/capacity ratio upper limit
- Minimum speeds
- A, B coefficients by speed buckets
- Lookup tables by speed bucket and V/C ratio

T3 Transformations

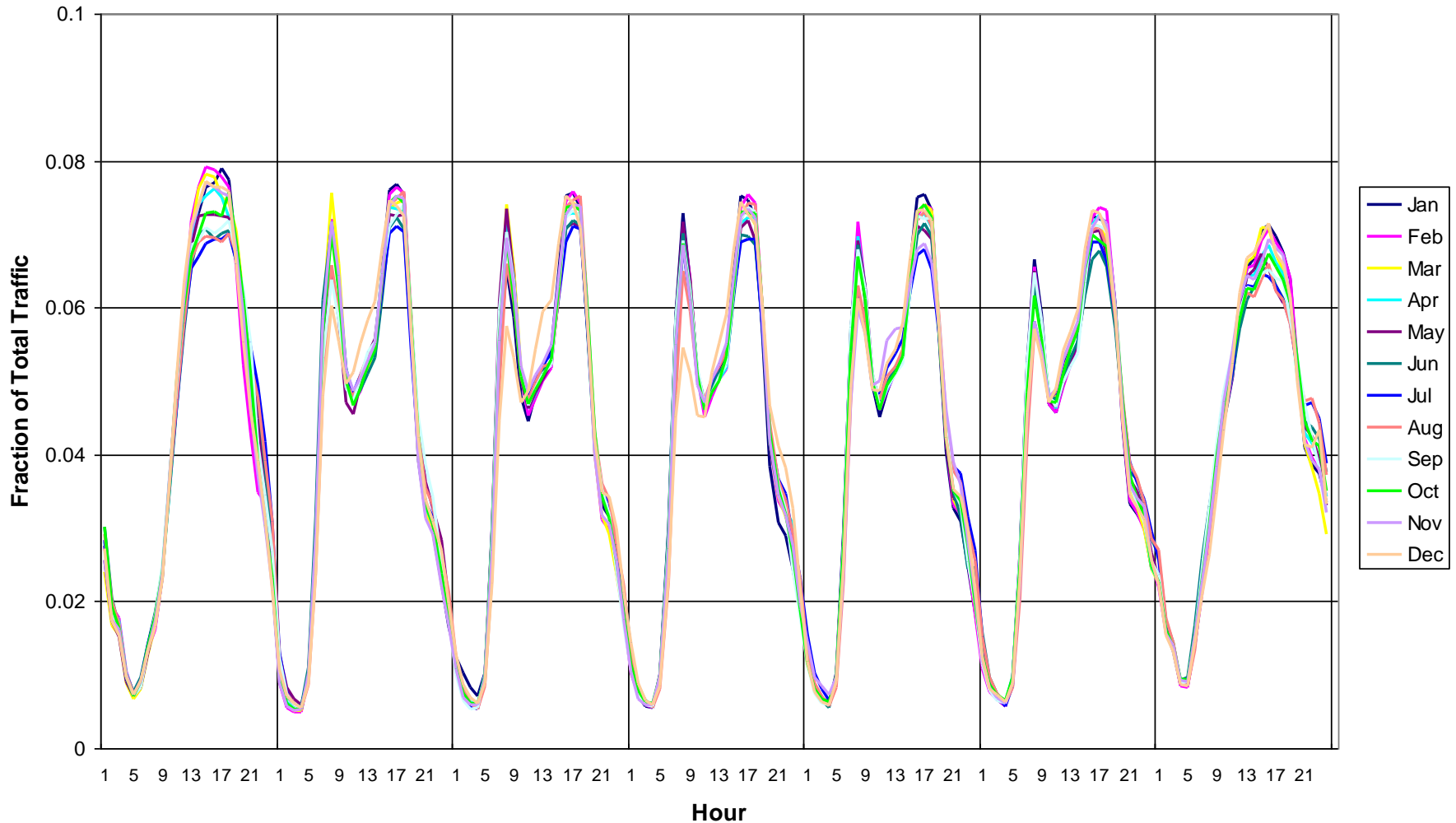
- Map Facility Types
 - Map TDM to HPMS facility types
 - CONCEPT maps HPMS to MOBILE6 facility types
- Apply HPMS Scaling Factors
- Apply VMT Growth Factors
- Include/Exclude Counties
- Develop TAZ to County Cross-Reference
 - Or treat TAZs as pseudo-counties in CONCEPT

T3/CONCEPT Temporal Allocation

- CONCEPT disaggregates T3 data (volume, VMT, capacities) for multi-hour periods into hourly volumes
- Requires hourly total volume profiles by HPMS facility class, month, day of week
- Develop profiles from analysis of automated traffic recorder (ATR) data

Example Temporal Profiles for Total Vehicle Count

Michigan Urban Interstate Hourly Profiles, Sunday through Saturday



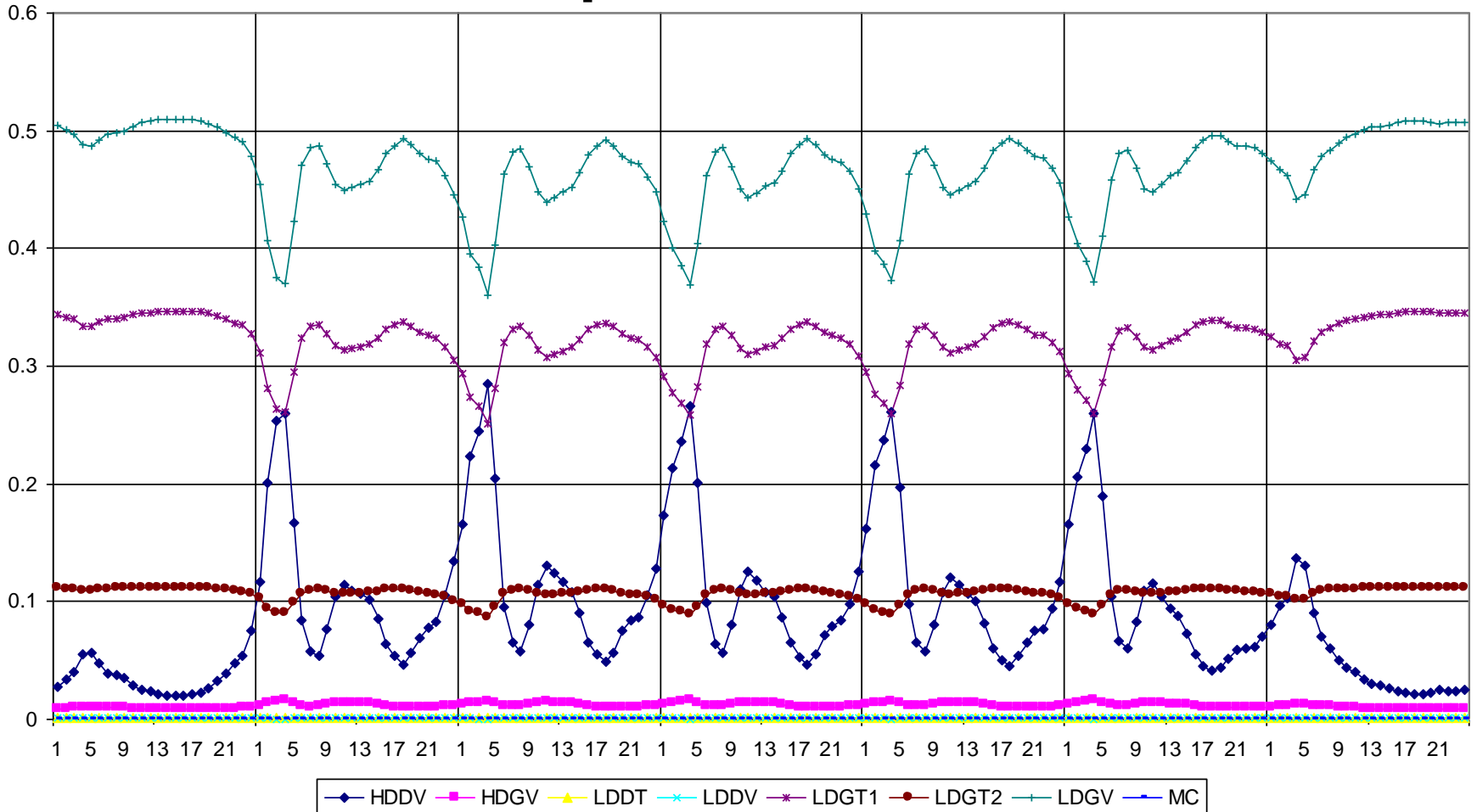
T3/CONCEPT Vehicle Mix Disaggregation

- CONCEPT disaggregates T3-formatted TDM vehicle classes into eight MOBILE5 vehicle classes
- Requires hourly VMT mix profiles by HPMS facility class, month, day of week, hour of day
- Develop hourly VMT mix profiles from analysis of vehicle classification recorder data

Example Vehicle Mix

Temporal Profile

Michigan Urban Interstate Hourly VMT Mix Fractions, Sunday through Saturday



CONCEPT Estimation of On-Road Motor Vehicle Emissions

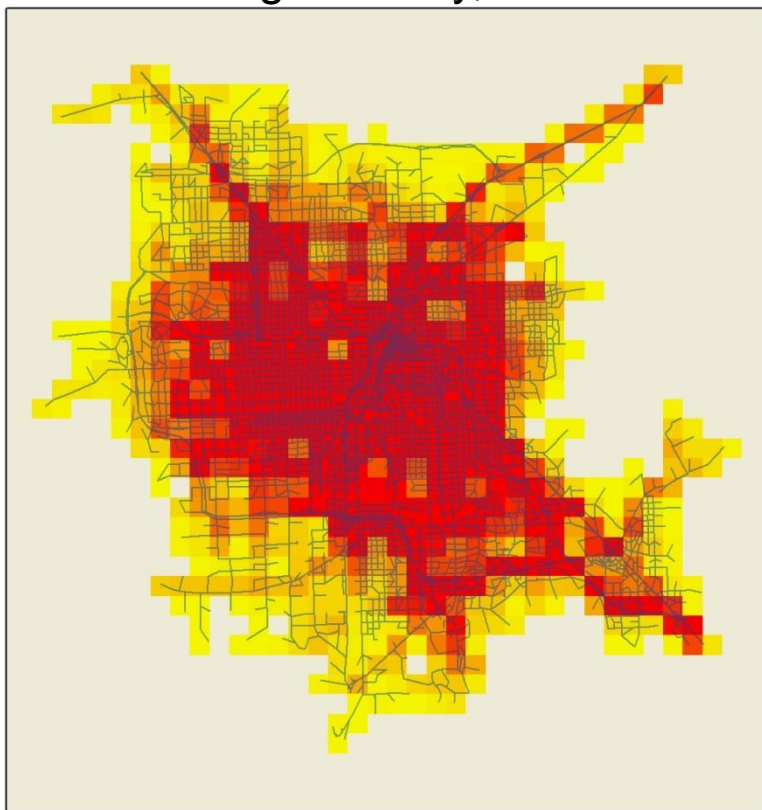
- Temporally allocate VMT to hours
- Adjust speeds
- Spatially allocate links to grid cells
- Allocate VMT to 8 MOBILE5 vehicle classes
- Run MOBILE6 with grid-specific meteorology
- Apply MOBILE6 Emission Factors
- Speciate emissions for air quality

CONCEPT MOBILE6 Runs

- Representative county inputs
 - Fuel parameters
 - Control programs
- Representative grid cell meteorology
- Year, Season
- Δ Temperature Bins
- Δ Speed Bins
- Road Type
 - Ramps and locals
 - Freeways and arterials by speed bin

Urban-Scale Applications

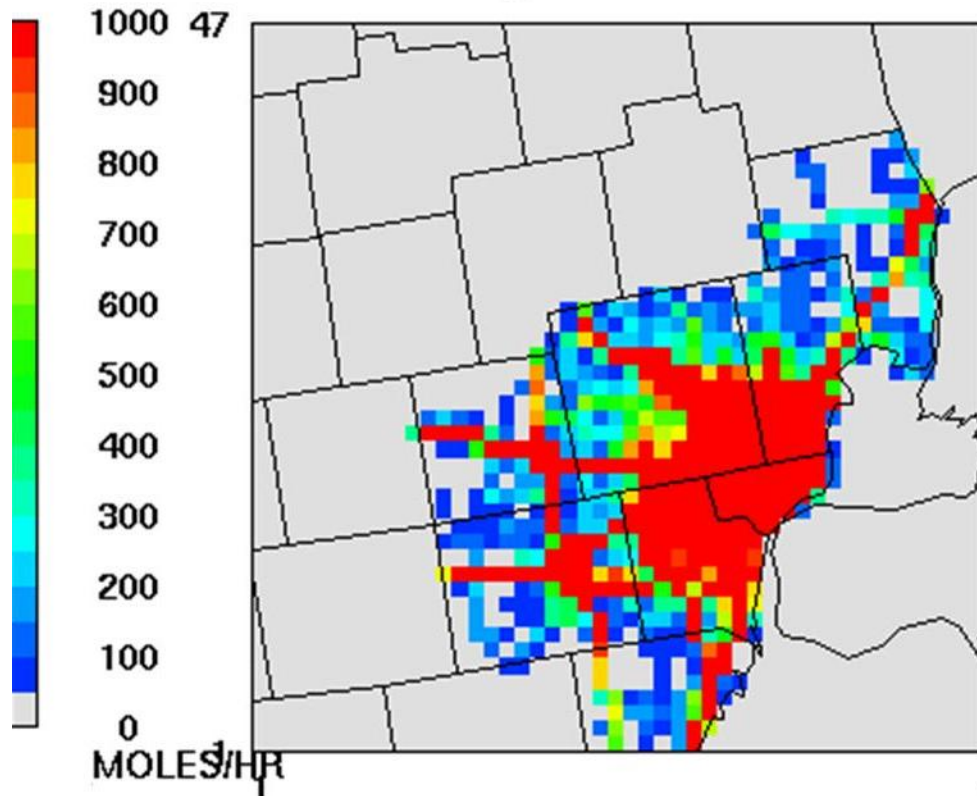
Las Vegas Valley, Nevada



Las Vegas TransCAD
CONCEPT MV
Gridded TOG Emissions - 1k

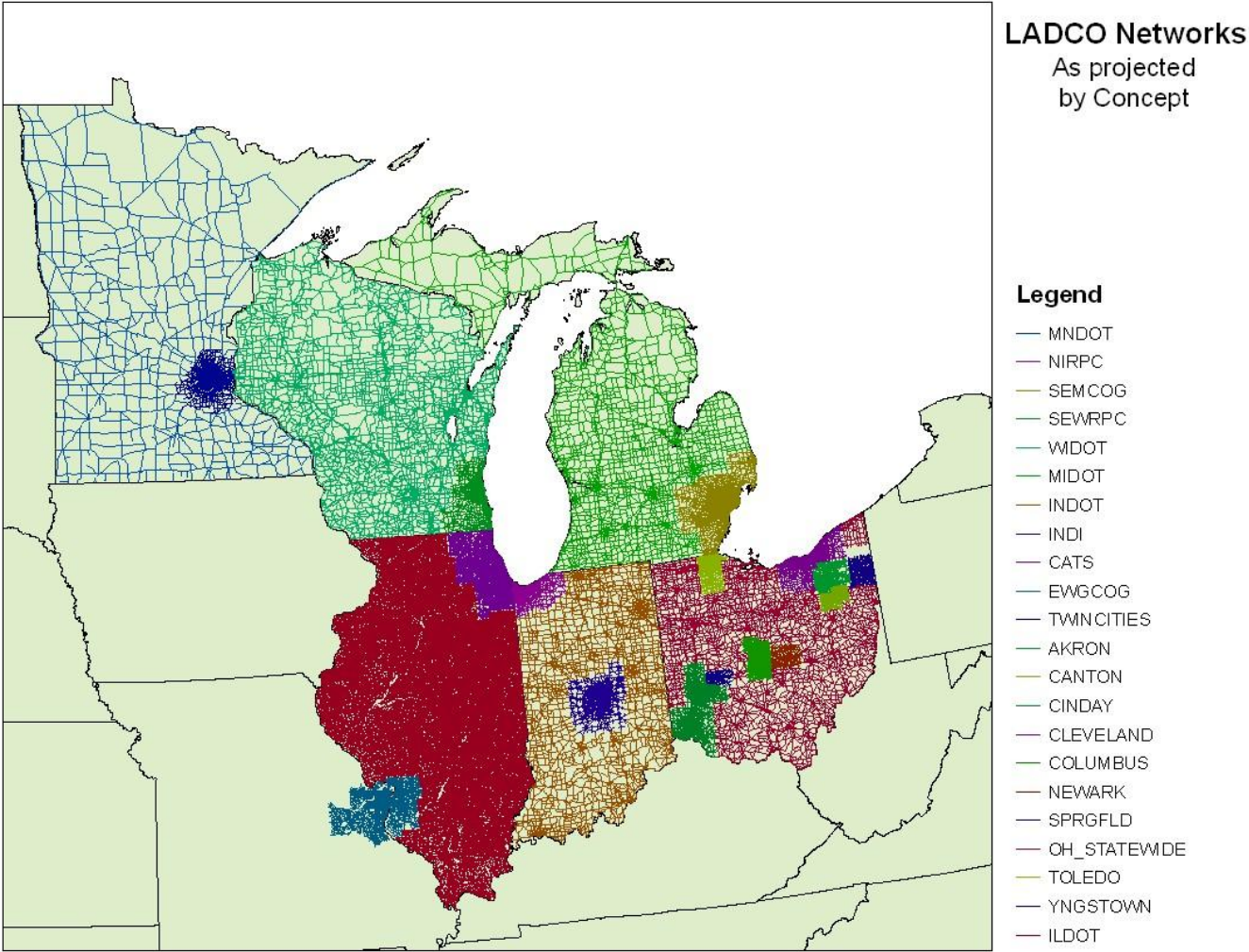


Detroit, Michigan Metro Area



July 12, 2002 15:00:00
Min= 0 at (1,1), Max= 7728 at (34,16)

Regional Application: LADCO States Combination of 22 State and Local Networks



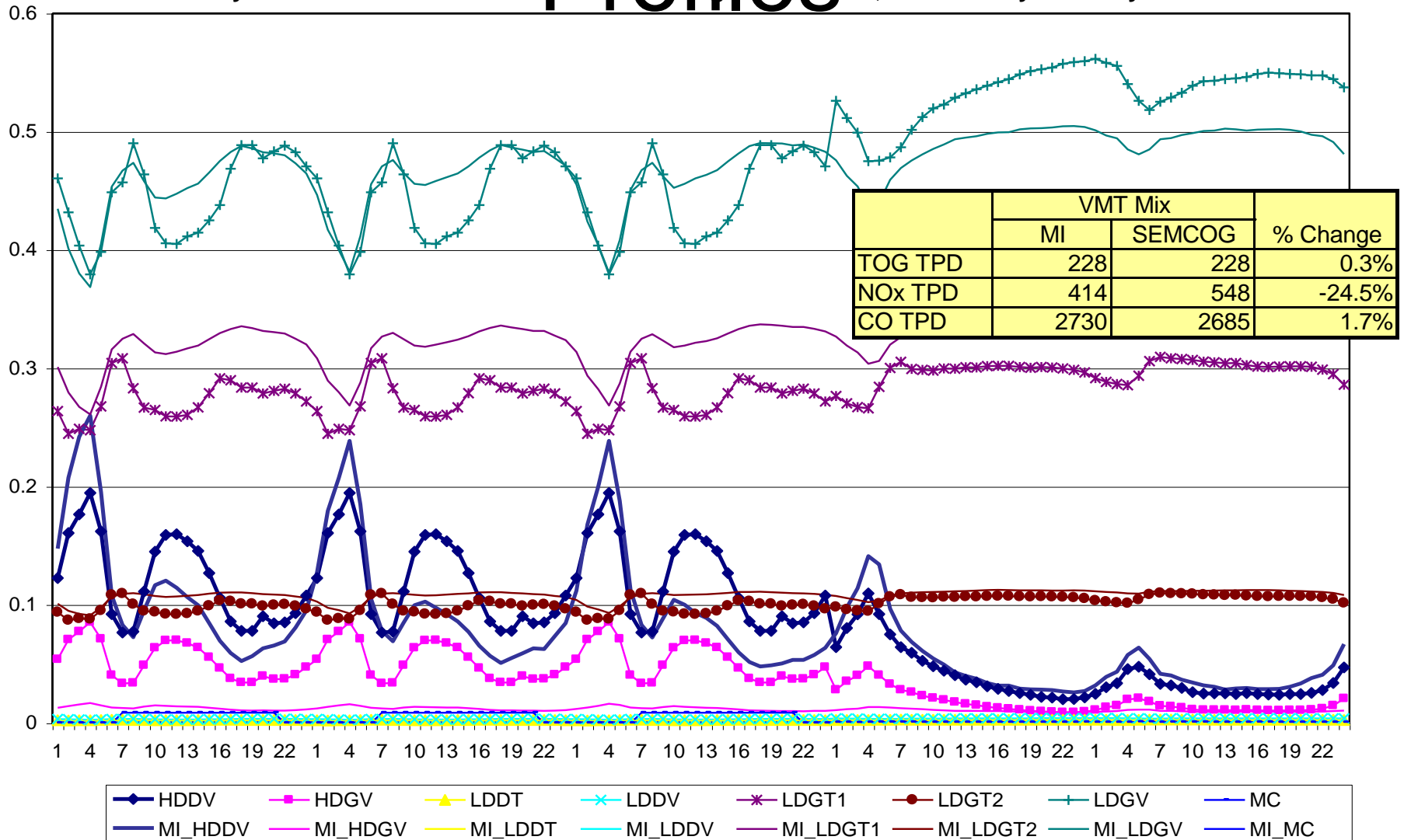
LADCO 2002 Networks Data

Processed

State	Network	TDM	# Links
Illinois	CATS - Chicago Area	EMME2	33,774
Illinois	ILDOT Statewide	Generated from Observed	303,297
Indiana	MPO - Indianapolis	TransCAD	7,599
Indiana	NIRPC - Northwest Indiana	EMME2	9,023
Indiana	INDOT Statewide	TransCAD	31,181
Michigan	SEMCOG - Detroit Area	TransCAD	14,985
Michigan	MIDOT Statewide	TransCAD	9,227
Minnesota	MMC - Minneapolis St. Paul Area	TP+	20,898
Missouri	EWGCOG – St. Louis Area	CUBE - TP+/Voyager	40,394
Minnesota	MNDOT Statewide	Generated from Observed	4,402
Ohio	Nine Urban Areas	CUBE-TRANPLAN	3,723 to 29,796
Ohio	OHDOT Statewide	TransCAD	50,644
Wisconsin	SEWRPC - Milwaukee Area	TRANPLAN	17,054
Wisconsin	WIDOT Statewide	TP+/VIPER	143,327
Total Links			801,467

Importance of VMT Mix Profiles

Urban Freeway Vehicle Mix: SEMCOG Profiles vs Michigan Statewide, Wednesday - Sunday



CONCEPT MOVES

Implimentation

- MOVES is very slow.
- Runs only on Windows(Not Linux)
- CONCEPT will have to use pre-generated Emission factor tables.
- Will have to create new emissions calculators that are faster but less transparent.