



Texas-Specific Drive Cycles for the EPA MOVES Model

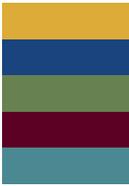
Nick Wood

Reza Farzaneh

TRB Transportation Planning Applications Conference

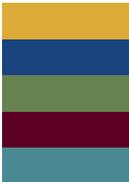
May 6th, 2013





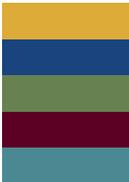
Study Overview

- Enhance Texas emissions inventories through incorporating Texas-specific data
 - Focusing on local drive cycles for major urban areas
- Collect and assemble Texas-specific data on drive cycles for:
 - Different vehicle types
 - Roadway classes
 - Urban areas of Texas



Approach

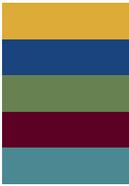
- Identifying information sources
- Data collection protocol development
- Recruiting participants
- Collecting data
- Processing data
- Data Analysis



Vehicles and Drive Schedules in MOVES

- MOVES' default drive schedules: grouped into three major categories based on the class of vehicles they are representing

Vehicle Class	Source Type ID	Description
Light Duty	11	MotorCycle
	21	Passenger Car
	31	Passenger Truck: SUV, Pickup Truck, Minivans - Two-Axle/Four-Tire Single Unit
	32	Light Commercial Trucks - Two-Axle/Four-Tire Single Unit
Buses & Medium-Duty	41	Intercity Buses
	42	Transit Buses
	43	School Buses
	52	Single-Unit Short-Haul Trucks
	53	Single-Unit Long-Haul Trucks
	54	Single- Unit Motor Homes
Heavy Duty	51	Refuse Trucks
	61	Combination Short-Haul Trucks
	62	Combination Long-Haul Trucks



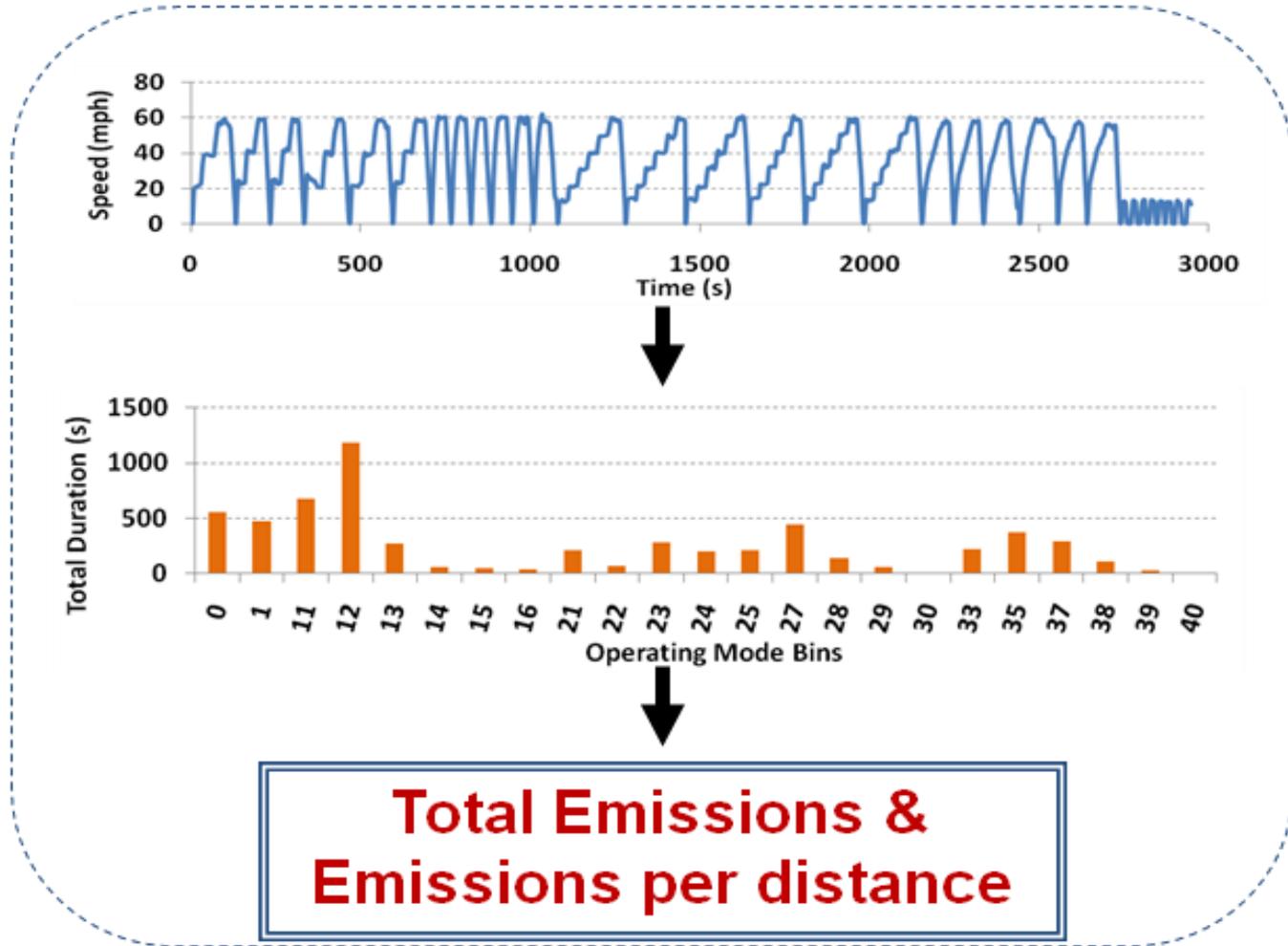
Vehicle Running Activities in MOVES

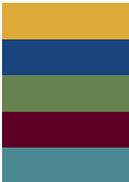
- Drive Schedule/Drive Cycle:
 - A second-by-second vehicle speed profile representing a specific mode of operation
- Vehicle Specific Power (VSP)
 - Function of speed and acceleration
- Operating Mode (OpMode)
 - Unit of activity in MOVES
 - Drive cycles translated to OpMode distribution
 - Emissions rates are organized based on OpMode bins

Operating Modes for Running Activities

Braking (Bin 0)			
Idle (Bin 1)			
VSP / Instantaneous Speed	0-25 mph	25-50 mph	> 50 mph
< 0 kW /tonne	Bin 11	Bin 21	
0 to 3	Bin 12	Bin 22	
3 to 6	Bin 13	Bin 23	
6 to 9	Bin 14	Bin 24	
9 to 12	Bin 15	Bin 25	
12 and greater	Bin 16		
12 to 18		Bin 27	Bin 37
18 to 24		Bin 28	Bin 38
24 to 30		Bin 29	Bin 39
30 and greater		Bin 30	Bin 40
60 to 12			Bin 35
< 6			Bin 33

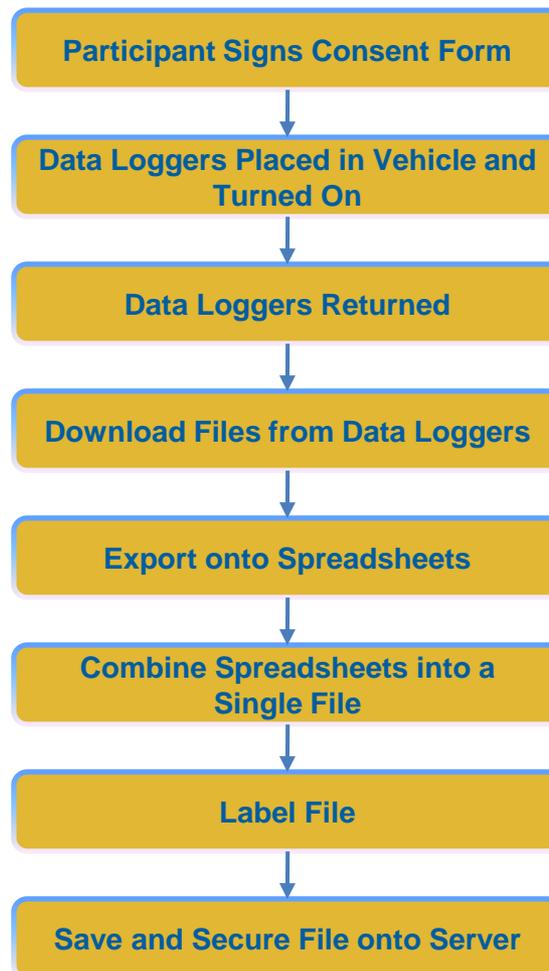
Emission Estimation in MOVES

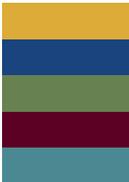




Data Collection Procedure – Drive Schedules

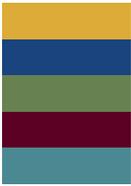
- Two parallel efforts
 - Normal driving
 - Planned routes
- Fleet vehicles and Individuals
- Two-week data collection period





Background: Speed Data Collection Instruments

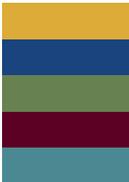
- Chase Car
 - Limited and expensive
- Instrumented Vehicles; e.g. DMI
 - Limited and expensive
- Engine Control Unit (ECU) Loggers
 - Relatively easy to deploy and inexpensive
 - No location data and not as accurate as GPS
- Global Positioning System (GPS)
 - Accurate, location data, easy to deploy and inexpensive



Data Collection Instruments

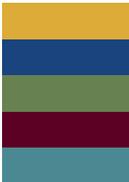
- Off the shelf units with motion sensor activation
- Self-supported, did not need any connection to the vehicle
- Power could last for 2 weeks
- Three units at the same time





Recruiting Vehicles for Data Collection

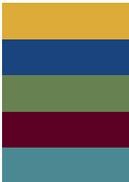
- Fleet partners for medium and heavy duty
 - Public and private fleets
- Individuals for light duty
 - Some were compensated \$75 for two weeks of activity
- Expected 140 individual vehicles (all classes)
- Up to 24 vehicles that followed a planned route



Placing GPS Assemblies

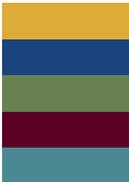
- Unit distribution
 - Given to passenger vehicle drivers
 - Installed in medium and heavy duty fleets
- Placed near the driver seat, so movement could actuate device
- Information collected during installation:
 - Vehicle Make
 - Model
 - Year
 - Fuel Type
 - Weight
 - VIN (medium & heavy)





Downloading and Importing Data

- Direct download from device to computer
- Data elements collected:
 - Date & Time
 - Latitude & Longitude
 - Speed
 - Heading



Processing Geospatial Data

1) Gave each file a distinct name

2) Data was checked for quality

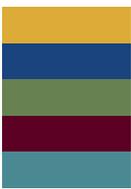
Ensured second-by-second records were continuous

Flagged accelerations greater than 10 mph/sec

Flagged any changes in heading of 30+ degrees

3) Merged data from three devices

Speeds averaged together only for devices within 2-mph speed range



Processing Geospatial Data... cont

4) Second iteration of checking continuity and acceleration

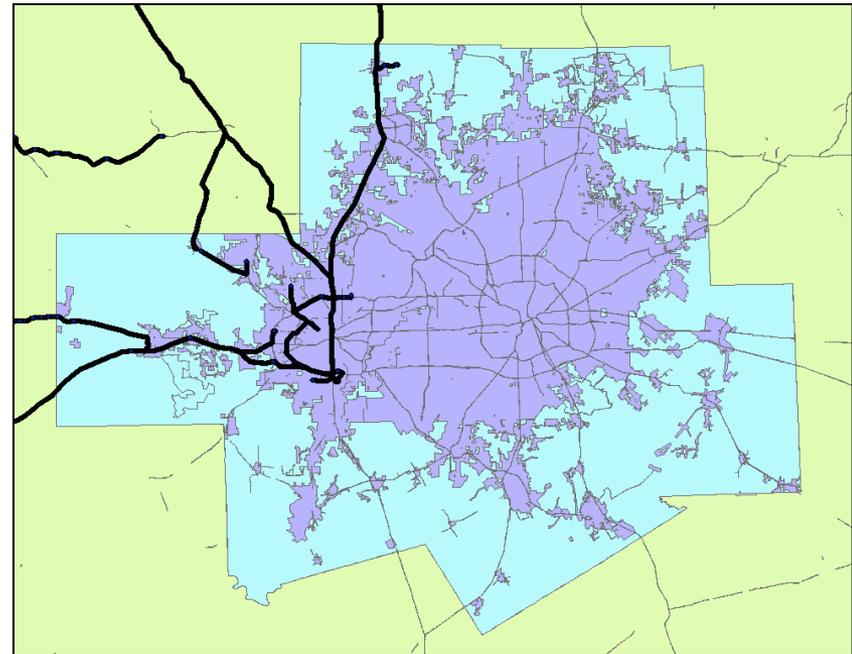
5) Matched location data

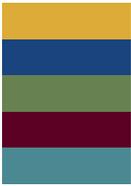
- Metro Region
- Roadway Classification

6) Generate Micro-Trips

- Start at zero speed and speed breaks
- Cannot be longer than 2 mi.

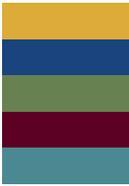
7) Create Unique Trip Index





Next Steps – Drive Cycle Development and Validation

- Create local drive schedule database as part of final deliverable
 - Combine micro-trips to generate drive cycles
 - Using methodology for MOBILE 6 and MOVES
- Quality control combining GPS and engine data
- Compare results with default MOVES values



Questions?

Nick Wood (nickwood@tamu.edu)