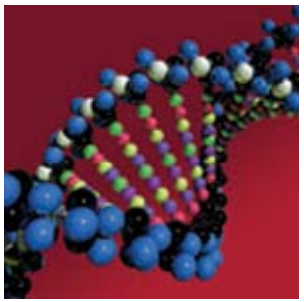
The Integration of MOVES and SMOKE:

Development of Driver and Post-Processing Scripts to use MOVES Emission Factors in SMOKE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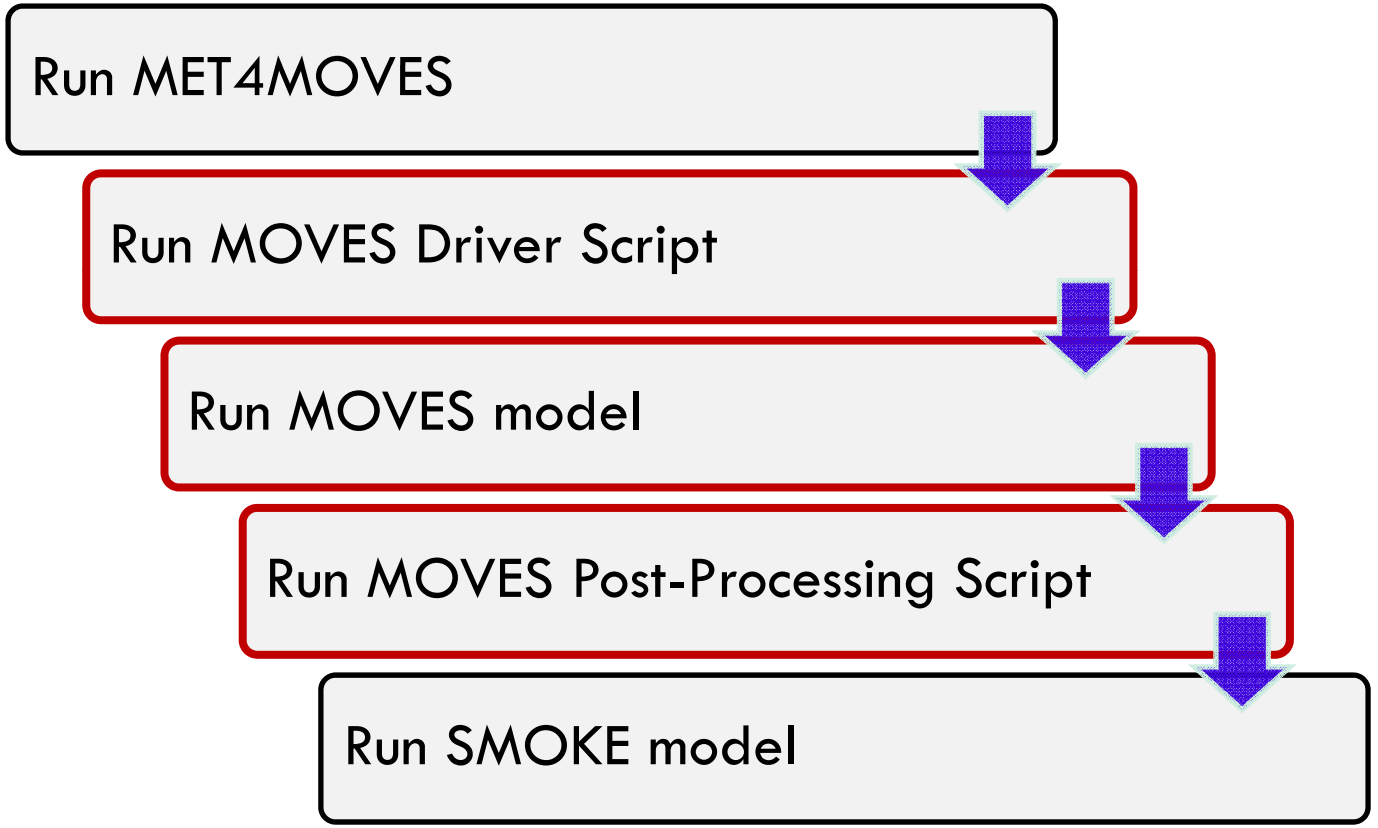
SMOKE-MOVES Tool



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Overview

- MOVES Background
  - Inventory vs. Emission Rate Calculation Type
- Driver Script
  - MOVES run setups cover range of conditions
  - MOVES run conditions differ by emission process
- MOVES Post-Processing Script
  - PM speciation
  - Formatting for SMOKE

MOVES Inventory vs. Emission Rates

Local Parameters

Fuel Specifications

Control Programs

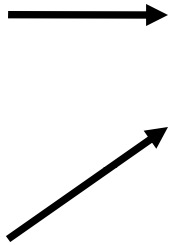
Vehicle Age Distributions

Activity Data

Vehicle Miles Traveled

Vehicle Population

Speed Distributions



MOVES

1) Inventory Calculation
   - Emission inventories by county

OR

2) Emission Rate Calculation
   - Lookup tables of emission factors
     - Running (g/mile)
     - Starts (g/vehicle-hour)
     - Extended Idle (g/vehicle-hour),
     - Evaporatives (g/vehicle-hour)

MOVES as an Emission Rate Model

Emission Process	RatePerDistance (grams/mile)	RatePerVehicle (grams/vehicle/hr)	RatePerProfile (grams/vehicle/hr)
Running Exhaust	X		
Crankcase Running Exhaust	X		
Brake Wear	X		
Tire Wear	X		
Evaporative Fuel Vapor Venting	X		X
Evaporative Permeation	X	X	
Evaporative Fuel Leaks	X	X	
Start Exhaust		X	
Crankcase Start Exhaust		X	
Extended Idle Exhaust		X	
Crankcase Extended Idle Exhaust		X	

- Lookup by speed, temperature, humidity, day type, year, month, county
- **Reference County** and **Fuel Month** as lookup

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MOVES Driver Script

- Written in Perl
- Automates set up of MOVES runs
- Approach varies by lookup table type
- Input
  - Temperature and Humidity from MET4MOVES
  - File paths to other MOVES input data
- Output
  - Batchfile of data files for MOVES to import into MySQL
  - Batchfile of runspec files to MOVES to run

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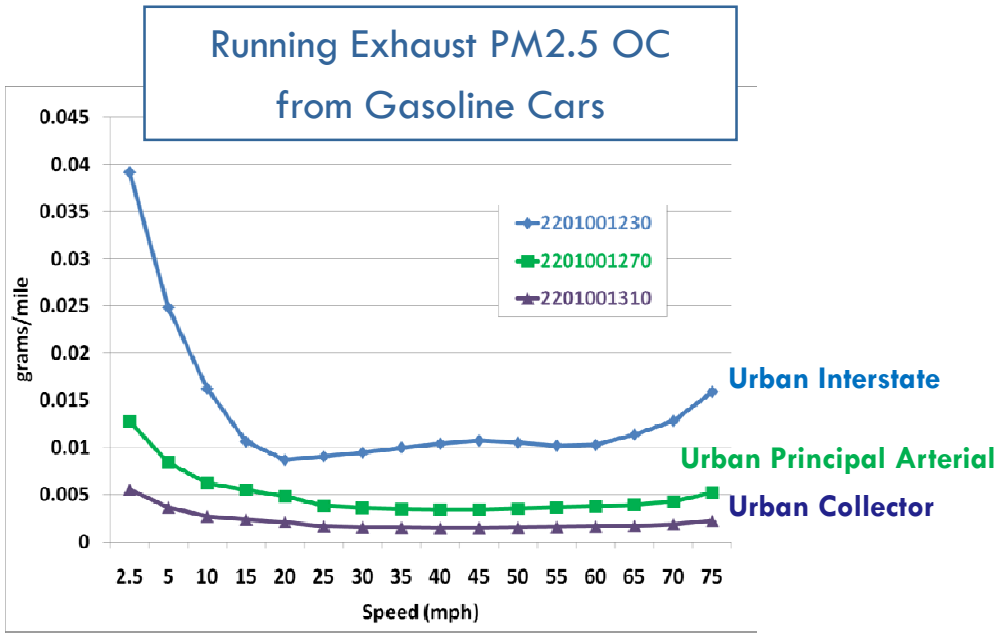
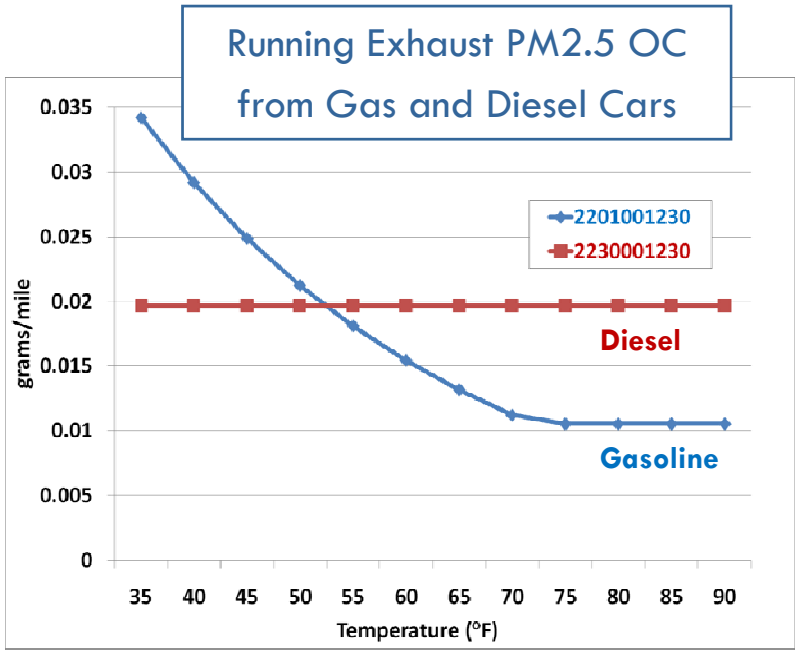
MOVES Driver Script
RatePerDistance Approach

- Reads MET4MOVES output
  - Relative humidity
  - Minimum and maximum temperature
- Bin temperatures as (Max-Min)/Increment
  - Example: min/max 36.2°F/88.7°F and 5° increment
  - Temperature bins become (35°, 40°, 45°, … ,85°, 90°)
- Assigns binned temperatures to hours of the day

RatePerDistance Emission Rates



Temperature = 75 F Relative Humidity = 63.5 %



Speed = 50 mph Relative Humidity = 63.5 %

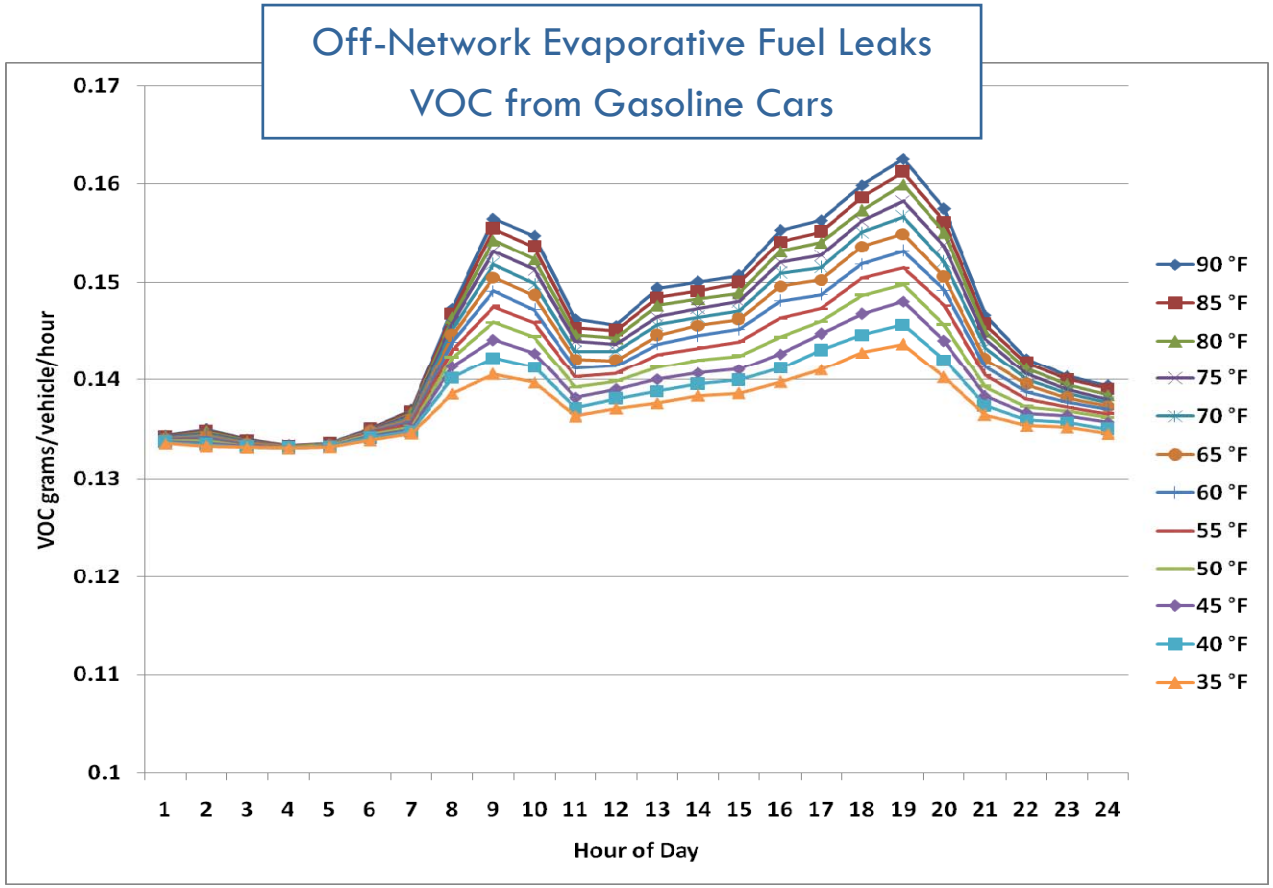
RatePerDistance emission rates depend on:

- Temperature
- Speed
- Humidity

MOVES Driver Script
RatePerVehicle Approach

- MET4MOVES min/max temperature, average RH
  - Temperature binning increment different by MOVES table
- Assigns each binned temperature to all hours of a run day
- Number of MOVES run days equals number of temperature bins
- Interaction of hour and temperature important

RatePerVehicle Emission Rates



RatePerVehicle emission rates depend on:

- Temperature
- Humidity
- Hour
- Day Type

MOVES Driver Script

RatePerProfile Approach

- Evaporative Fuel Vapor Venting emissions affected by temperatures in previous hours
- MET4MOVES **diurnal temperature profiles**
  - Geographic average → normalized 24-hour temperature profile
  - Normalized shape fitted with binned range of min/max temperatures

(min, max) temperatures:

(30, 30) (40, 40) (50, 50) **(60, 60)** (70, 70) (80, 80) **(90,90)**
(30, 40) (40, 50) (50, 60) **(60, 70)** (70, 80) (80, 90)
(30, 50) (40, 60) (50, 70) **(60, 80)** (70, 90)
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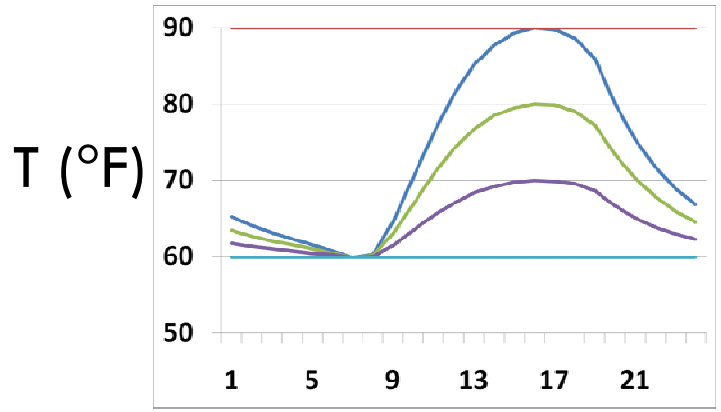
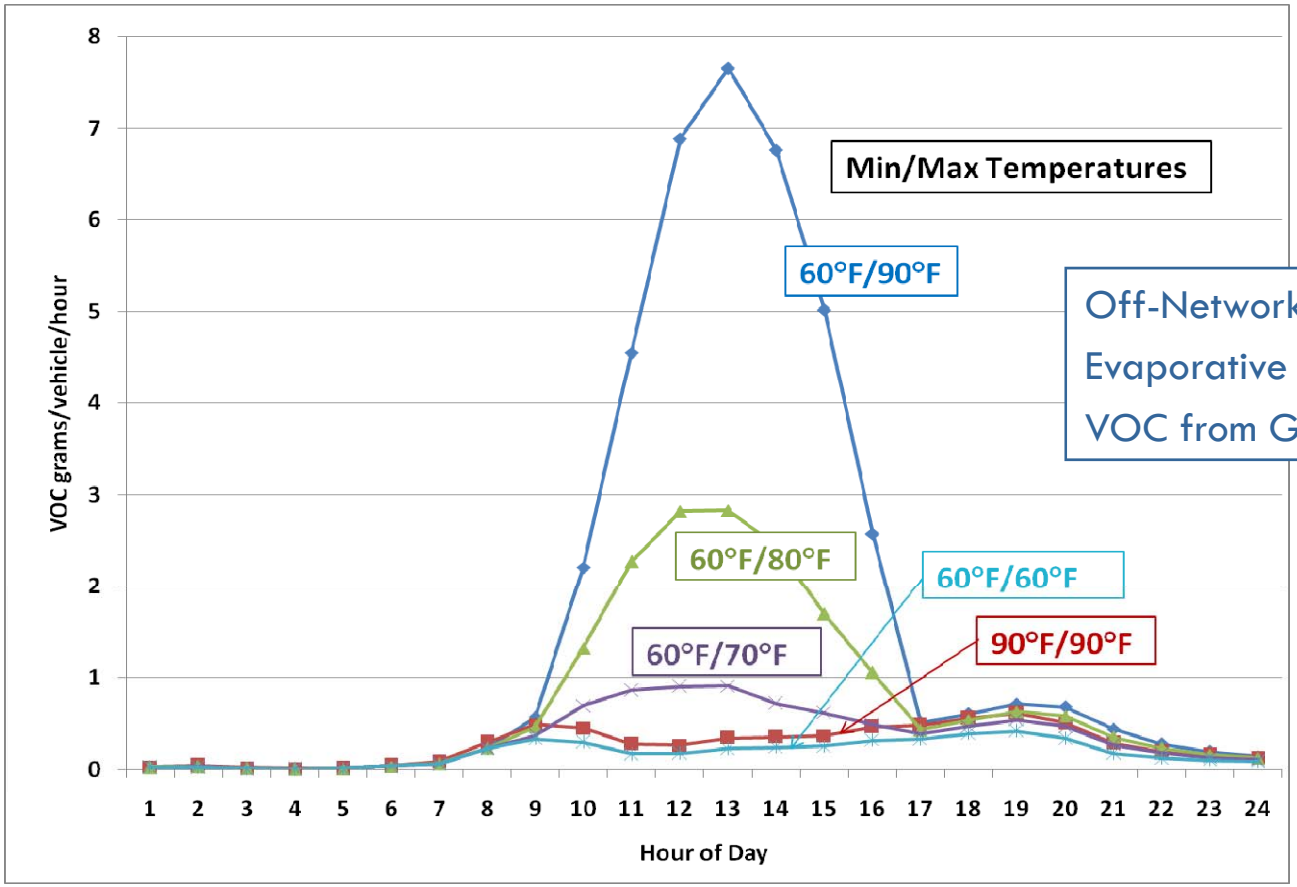


RatePerProfile Emission Rates



RatePerProfile emission rates depend on:

- Temperature
- Hour
- Diurnal Temperature Gradient
- Day Type

MOVES Post-Processing Script

- Written in Perl
- Interfaces with MySQL database
- Input
  - Raw MOVES lookup tables: RatePerDistance, RatePerVehicle, and RatePerProfile
- Outputs
  - Modified lookup tables: RatePerDistance_smoke, RatePerVehicle_smoke, and RatePerProfile_smoke
  - Revisions include
    - PM speciation
    - Formatting for SMOKE

MOVES Post-Processing Script: PM Speciation

- Fully speciates partially speciated PM2.5 from MOVES
  - MOVES outputs EC, OC, SO4
  - Script adds PNO3, METAL, NH4, PEC, POC, PMFINE, PMC
- Equations developed by EPA OAQPS
- Uses the MOVES EC/OC split rather than using the sum of EC+OC the past method

MOVES Post-Processing Script: Formatting for SMOKE

- Reduces file size
  - Cross-tab query on emissions by pollutant
  - Pollutant IDs in rows become additional field headings; emissions in rows moved to columns
- Other reformatting
  - Parse 5-digit county FIPS code from other fields
  - Assigns MOVES emission process ID (integer) to SMOKE ID (3-character text string)
  - Data sorting
- MySQL tables written to ASCII files

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Acknowledgements

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Questions?