

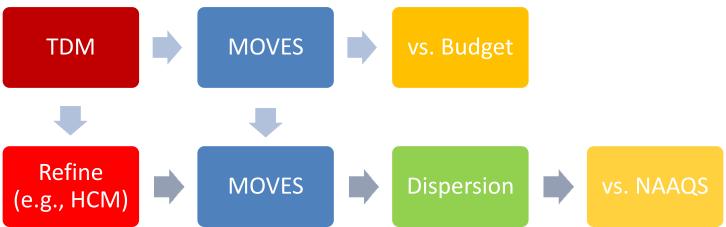
Models Used in Air Quality Analysis

September 15, 2016



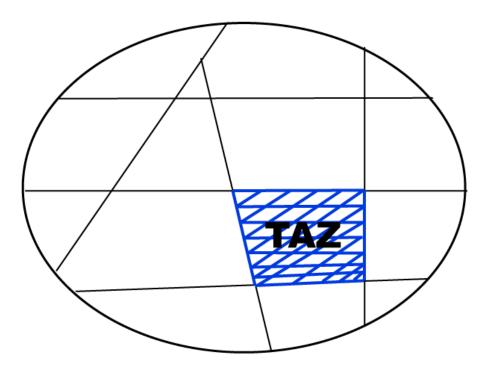
Overview

Regional Conformity



Project-Level (Hot-Spot) Conformity

How is an Area Represented in Network Modeling?

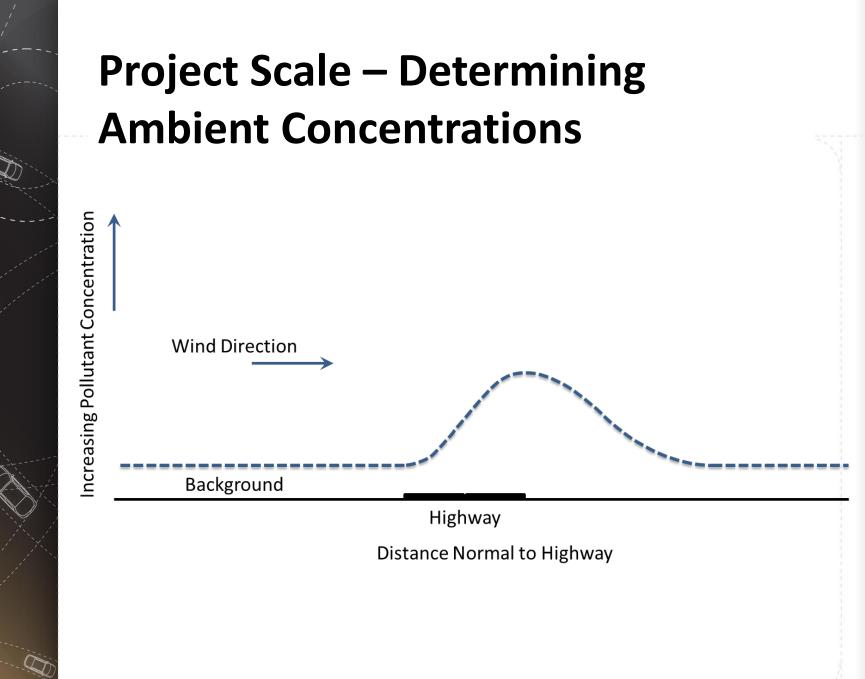


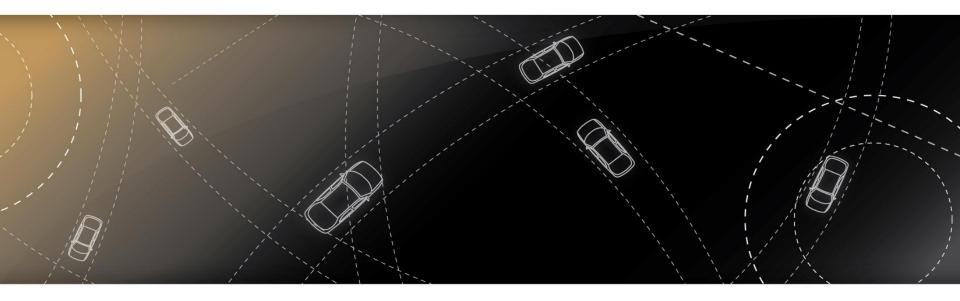
Emission Estimation Process

Activity •Vehicle Miles of Travel (VMT) •Idling Hours •Vehicle Population



Emission Rates •Rate Per Distance •Rate Per Vehicle •Rate Per Profile Vehicle Emissio ns





Models Used in Air Quality Analysis

Transportation Planning and Traffic Engineering

September 15, 2016

Traffic Considerations

Training Objectives

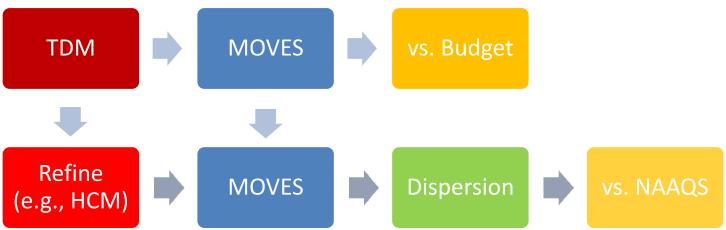
- Introduce Regional Traffic Data Concepts
- Introduce Project-Level Traffic Concepts
- Introduce the Role of Traffic Data in Air Quality Studies

A wide array of models and tools can be used. We won't cover any specifically, but look more broadly at the general concepts.



Traffic Considerations- Overview

Regional Conformity



Project-Level (Hot-Spot) Conformity

Traffic Considerations- Overview

- Key Factors
 - Traffic Volumes
 - Vehicle Speeds
- Data Sources
 - Historic Trends
 - Forecast Modeling
- Relationships
 - Exogenous
 - Endogenous



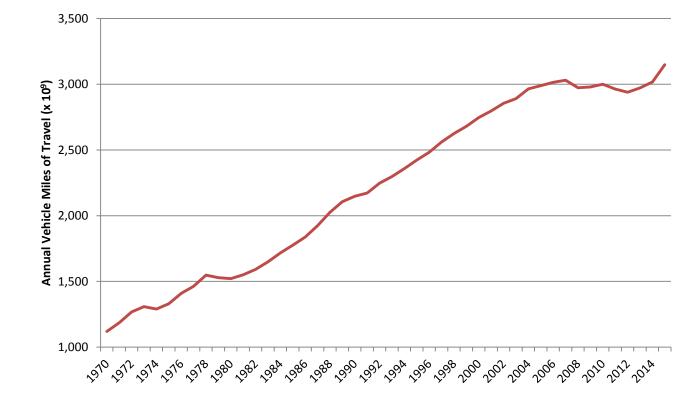
- How is the traffic?
 - When?
 - Where?



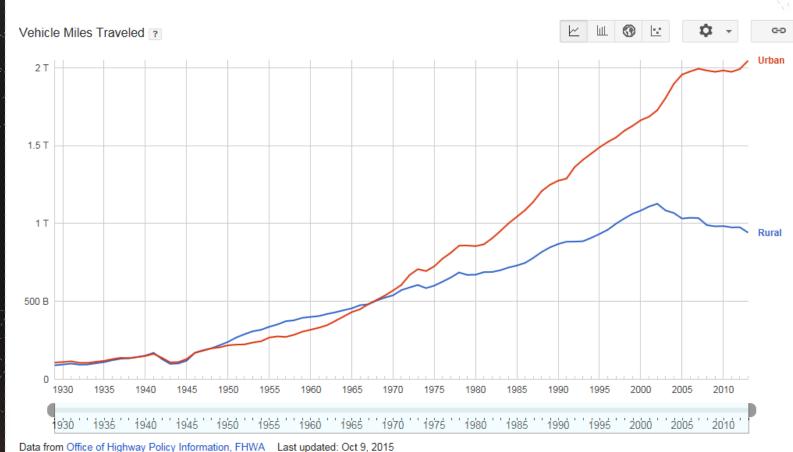


The answer is a moving target!

Annual Vehicle Miles of Travel (1970-2015)



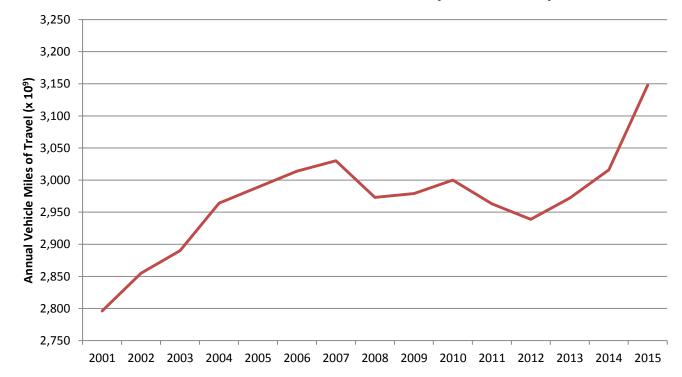
http://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm



©2014 Google - Help - Terms of Service - Privacy - Disclaimer - Discuss

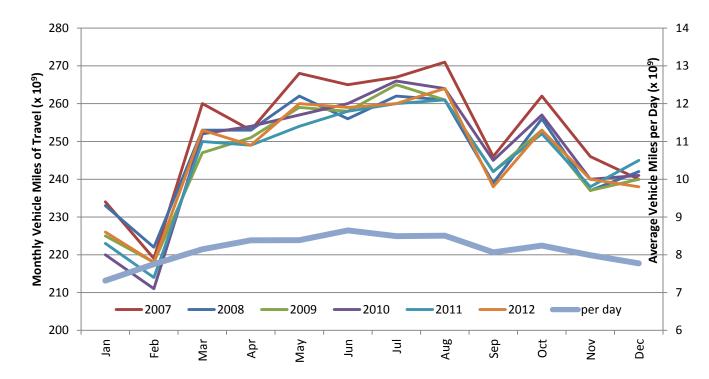
http://www.google.com/publicdata/explore

Annual Vehicle Miles of Travel (2001-2015)

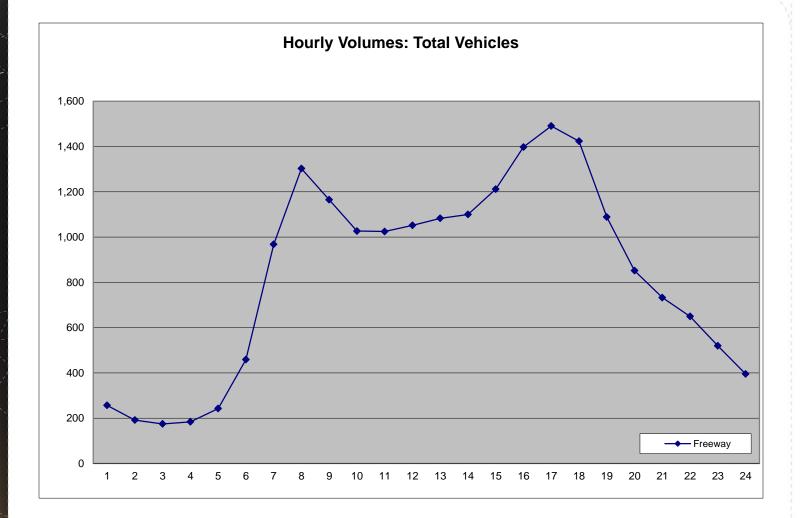


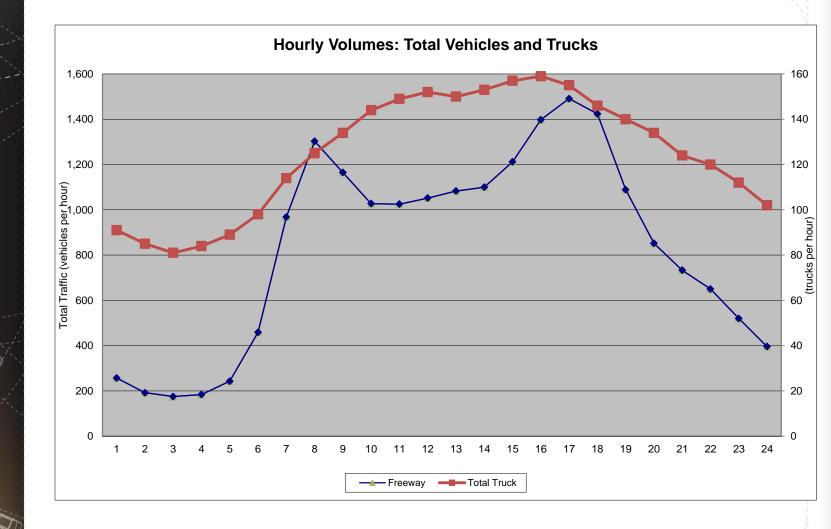
http://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm

Monthly Vehicle Miles of Travel (2007-2012)

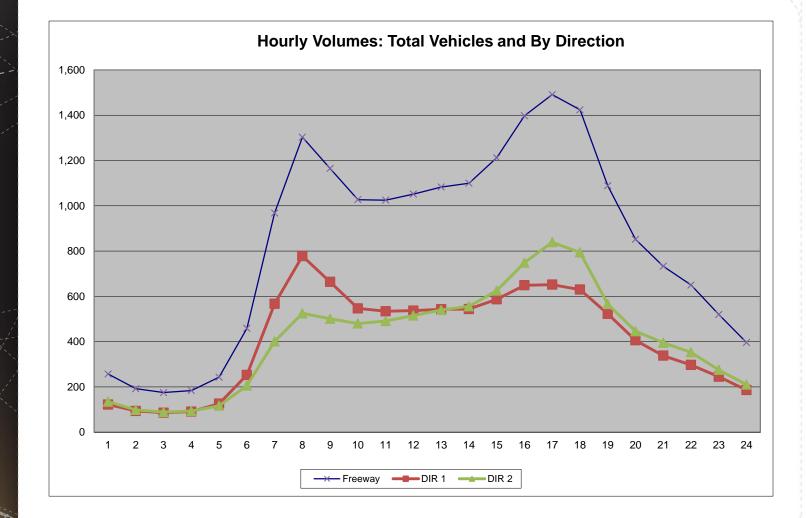


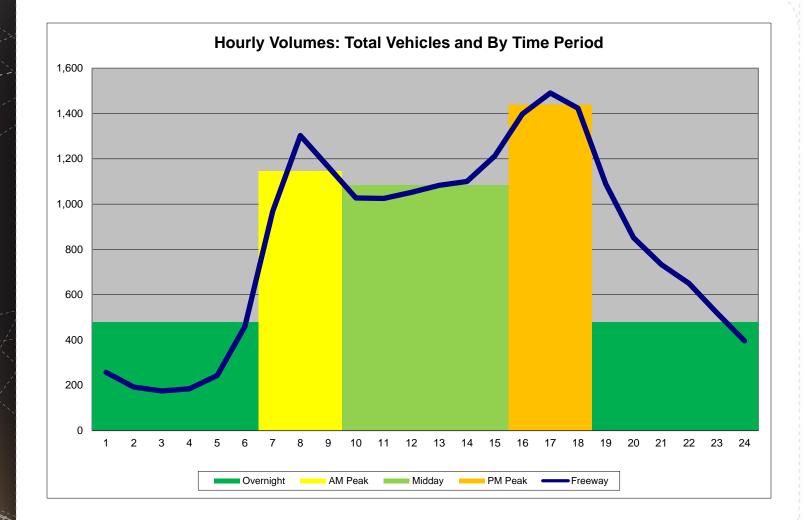
http://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm

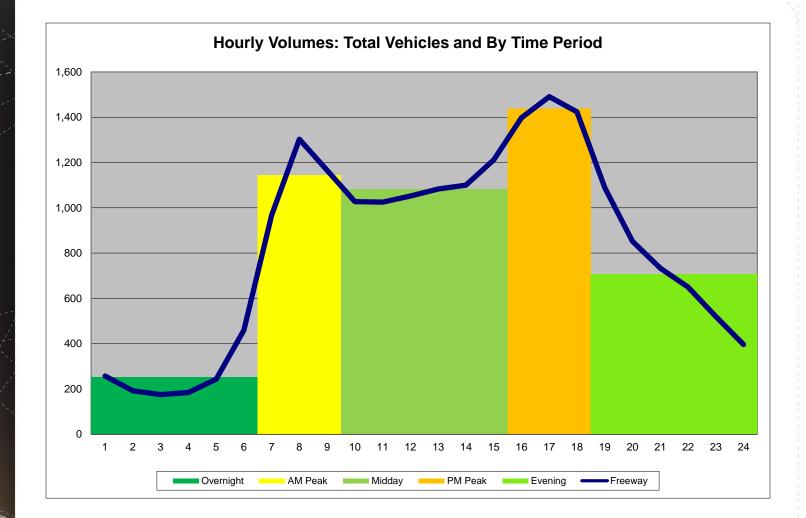




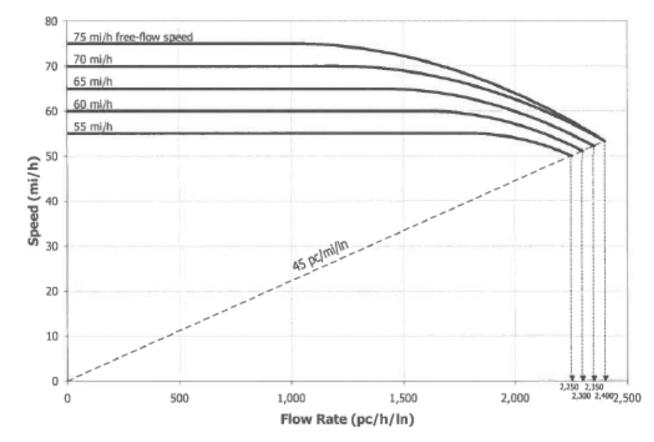
11



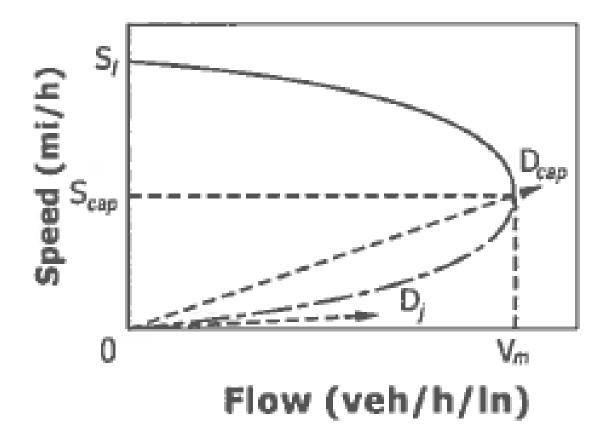




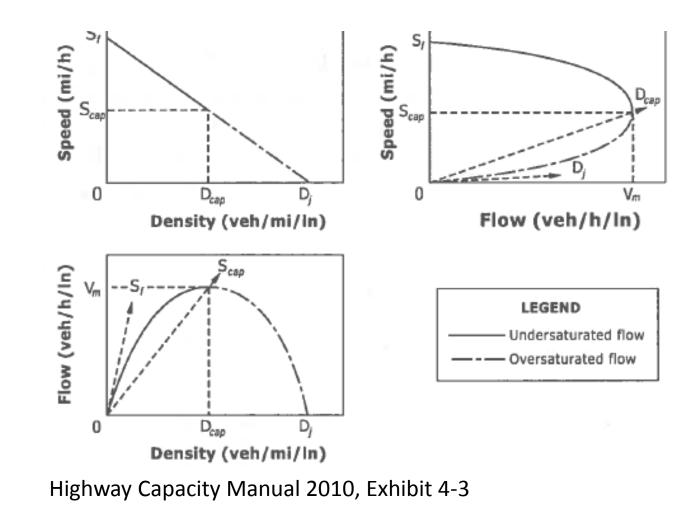
- A Couple Underlying Fundamentals
 - Travel is a "derived demand"
 - People don't travel just to travel
 - Travel with intention of completing a task at another location (e.g., go to work or shop)
 - Travel is a "cost" of that other task
 - Travel time is a big factor in that cost
 - Speeds are affected by a variety of factors
 - Reliability is a growing concern

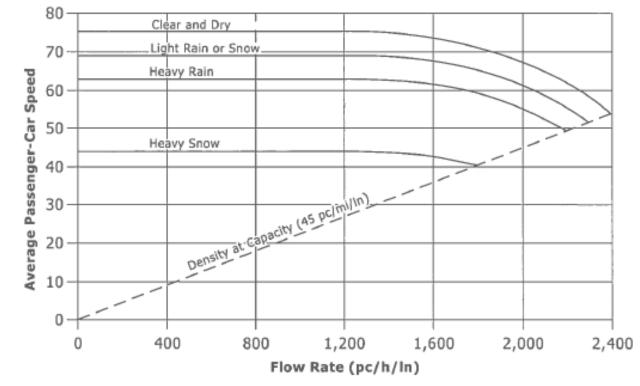


Highway Capacity Manual 2010, Exhibit 11-2



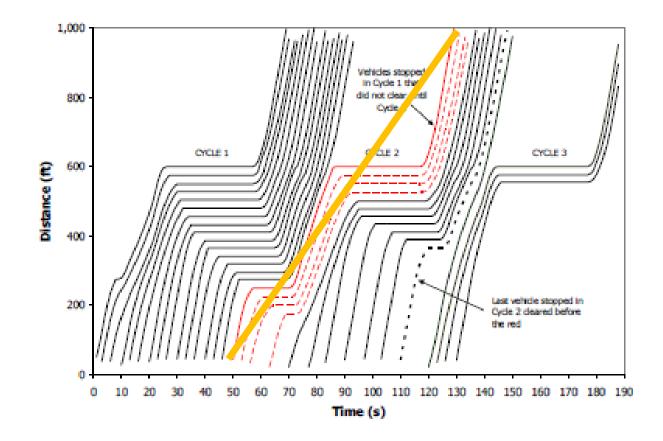
Highway Capacity Manual 2010, Exhibit 4-3



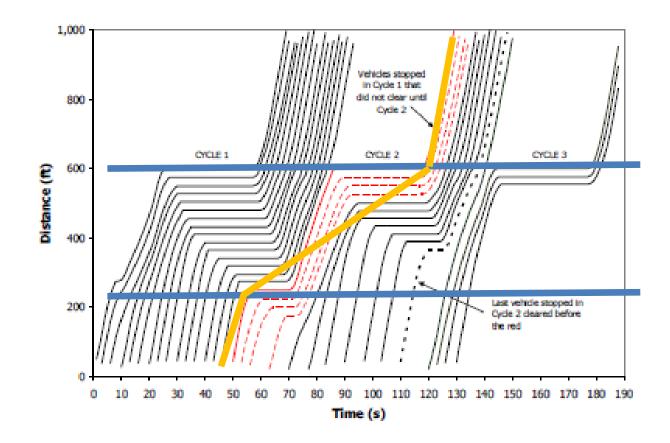


Note: Free-flow speed = 75 mi/h (base conditions).

Highway Capacity Manual 2010, Exhibit 10-18



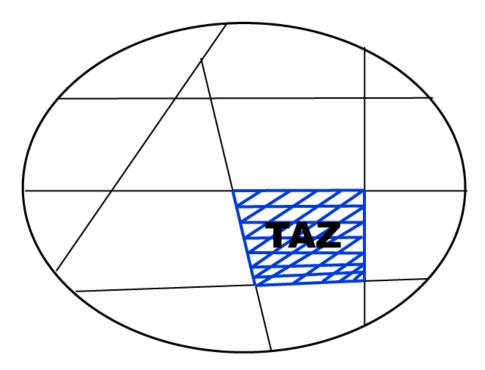
Highway Capacity Manual 2010, Exhibit 24-5



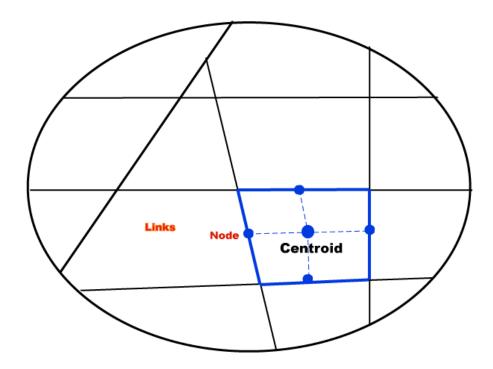
Highway Capacity Manual 2010, Exhibit 24-5

- In Urban Areas, Metropolitan Planning Organization (MPO) develops a regional Travel Demand Model (TDM)
- The area is divided into Traffic Analysis Zones (TAZs)
 - TAZs contain land use data (homes, jobs)
 - TDM represents travel between TAZs

How is an Area Represented in Network Modeling?



How is an Area Represented in Network Modeling?



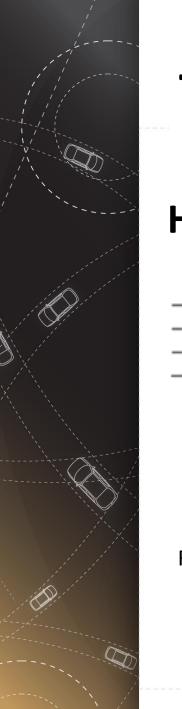
- Typical TDM Concept: 4 Step Model
 - Trip Generation
 - Trip Distribution
 - Mode Choice
 - Route Assignment
- Model at aggregate level over full area
- Meet network constraints
- Different Model Structures Available

- In typical application, MPO uses TDM volumes and speeds to complete regional conformity analysis
- Use TDM to assess viability of large scale projects (highway and transit) to set Transportation Improvement Program (TIP) and Long-range Plan
- Plan within financial constraints

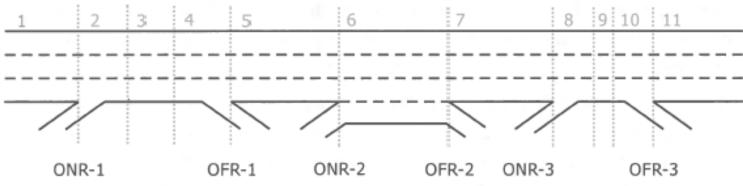
- Regional TDM provides basic volumes
 - Can forecast future year conditions
 - Speeds typically imprecise
 - Do not normally treat intersection delay
 - Still reflect relative congestion effects
- Need project-level analysis for details
 - Typically calculate Levels of Service
 - At intersections and other critical locations

In looking at a Project, consider:

- How will it affect where people go?
- How will it affect who goes by what mode?
- How will it affect what routes they use?
- How will it affect their time of travel?
- How will it affect on-road operations?
- How will it affect land use & future travel?
- Apply the same considerations for all alternatives

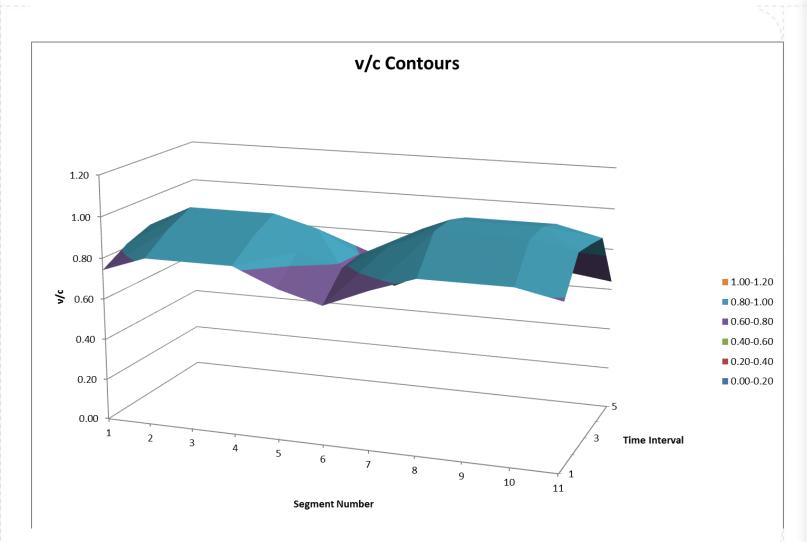


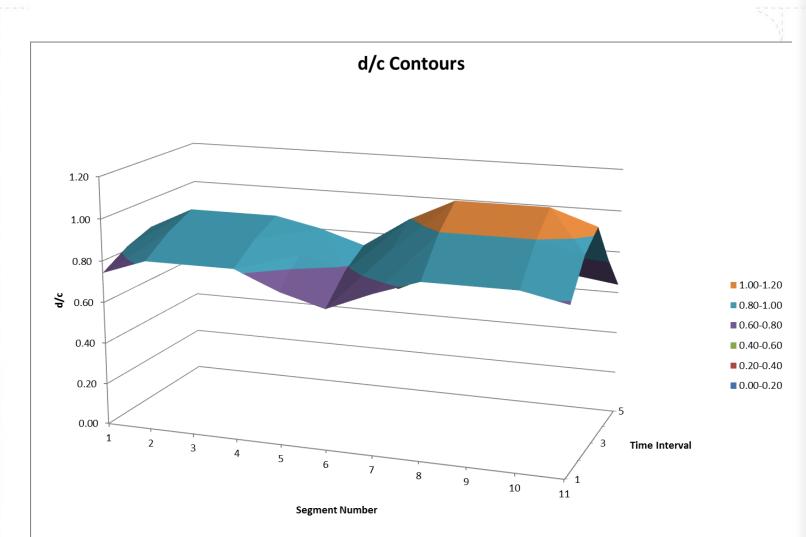
HCM Freeway Example



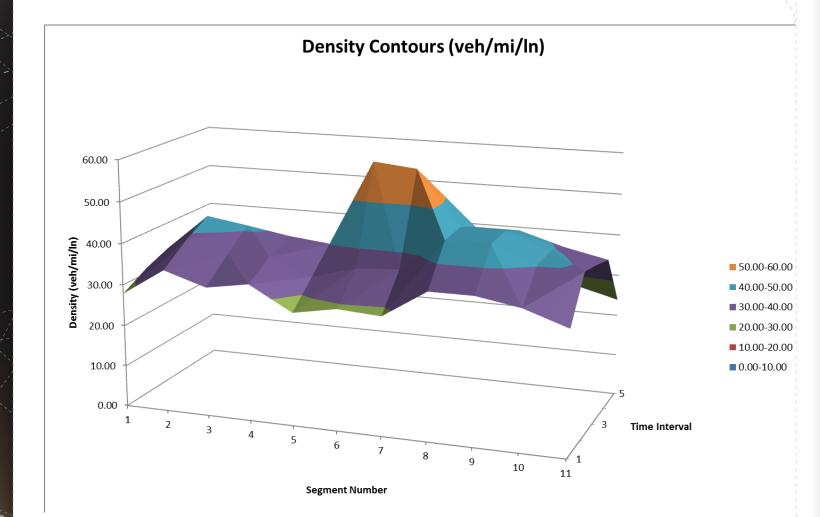
Ref: Highway Capacity Manual 2010, Exhibit 10-25

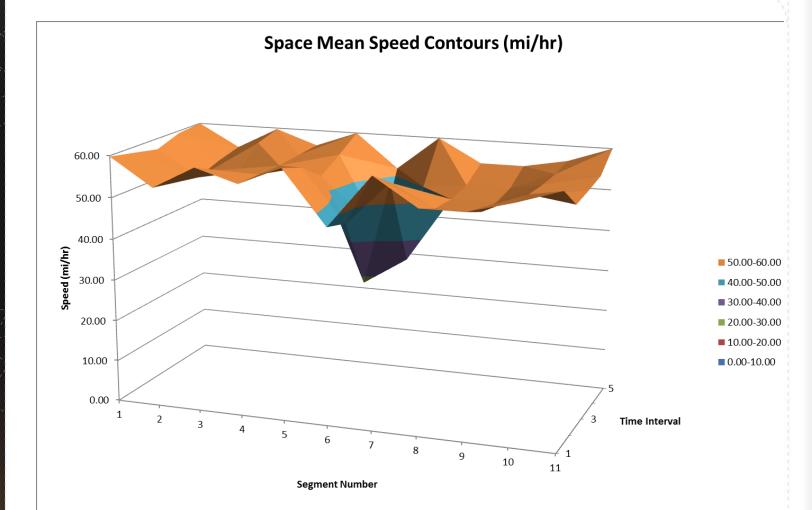
Facility-Level Summary	Release	June 25, 1	2011											
Title	HCM 201	0 Ch 10 Ex 2												
Number of ValidTime Intervals	5													
Period Duration (min)	75											SECTION A	ND	
											•	PERIOD TO	DTOTALS	
SEGMENT NUMBER :	1	2	3	4	5	6	7	8	9	10	11		units	
SEGMENT LABEL :	S01	ONR-1	S03	OFR-1	S05	S06	S07	ONR-3	S09	OFR-3	S11			
Input or estimated segment type (B,W,ONR,OFR)	В	ONR	В	OFR	В	W	В	ONR	R	OFR	В			
Segment length (ft)	5280	1500	2280	1500	5280	2640	5280	1140	360	1140	5280	6.00	miles	
Number of lanes	3	3	3	3	3	4	3	3	3	3	3			
Free flow speed (mi/hr)	60	60	60	60	60	60	60	60	60	60	60			
Maximum d/c ratio**	0.86	0.97	0.97	0.97	0.92	0.85	0.99	1.10	1.10	1.10	1.02	Oversaturated		
Time interval queueing begins					3	3	3							
Travel time nervehicle (min)	1.02	0.32	0.46	0.31	1.05	0.76	1.22	0.25	0.08	0.23	1.07		min	
Travel time per vehicle (min)		1995.7	3033.5				6849.3	1619.0	511.3					
VMTD Veh-miles (Demand)	6425.5 6425.5	1995.7	3033.5	1995.7 1995.7	6550.0 6550.0	3649.6 3649.6	6849.3	1619.0	511.3		7098.8 7098.8			
VMTV Veh-miles (Volume)		38.0												
VHT travel (hrs)	109.0		53.5		114.5		139.3	31.4	9.9		126.3			
VHD delay (hrs)	1.9	4.7	3.0	2.6	5.3		25.1	4.4	1.4		8.0		VHD	
Space mean speed = VMTV / VHT (mph)	58.93	52.58	56.68	55.64	57.22		49.17	51.60	51.60		56.21		mph	
Average density (vpmpl)	29.1	35.6	33.1	33.7	30.5		37.1	38.8	38.8		33.7		veh/mi/ln	
Average density (pcpmpl)	29.8	36.5	33.9	34.5	31.3	38.1	38.1	39.7	39.7	36.9	34.5	34.6	pc/mi/ln	

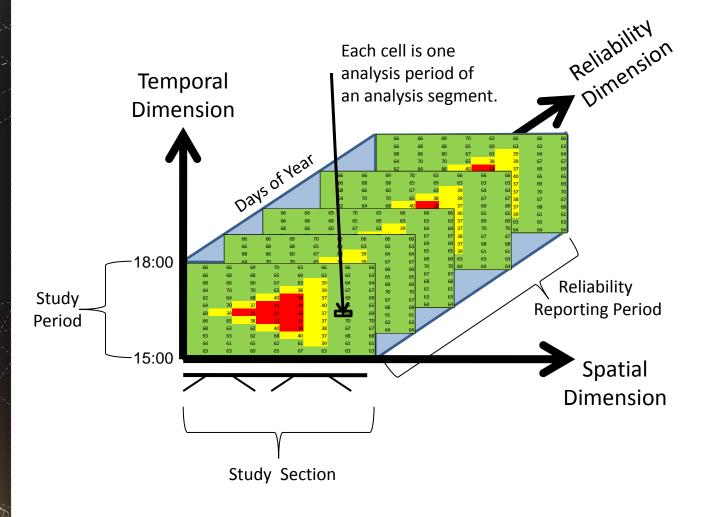




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#	Demand	Weather	Incident	Work Zone	Probability
1	Low	Clear	No	None	14.25%
2	Low	Clear	No	Lng.Trm 1	1.02%
3	Low	Clear	PDO-1	None	1.14%
4	Low	Clear	PDO-1	Lng.Trm 1	0.08%
5	Low	Med.Rain	No	None	1.14%
6	Low	Med.Rain	No	Lng.Trm 1	0.08%
7	Low	Med.Rain	PDO-1	None	0.09%
8	Low	Med.Rain	PDO-1	Lng.Trm 1	0.01%
9	Low	Lt.Snow	No	None	0.86%
10	Low	Lt.Snow	No	Lng.Trm 1	0.06%
11	Med	Clear	PDO-1	None	3.99%
12	Med	Clear	PDO-1	Lng.Trm 1	0.29%
13	Med	Clear	No	None	49.89%
14	Med	Clear	No	Lng.Trm 1	3.56%
15	Med	Med.Rain	PDO-1	None	0.32%
16	Med	Med.Rain	PDO-1	Lng.Trm 1	0.02%
17	Med	Med.Rain	No	None	3.99%
18	Med	Med.Rain	No	Lng.Trm 1	0.29%
19	Med	Lt.Snow	PDO-1	None	0.24%
20	Med	Lt.Snow	PDO-1	Lng.Trm 1	0.02%
21	High	Clear	No	None	14.25%
22	High	Clear	No	Lng.Trm 1	1.02%
23	High	Clear	PDO-1	None	1.14%
24	High	Clear	PDO-1	Lng.Trm 1	0.08%
25	High	Med.Rain	No	None	1.14%
26	High	Med.Rain	No	Lng.Trm 1	0.08%
27	High	Med.Rain	PDO-1	None	0.09%
28	High	Med.Rain	PDO-1	Lng.Trm 1	0.01%
29	High	Lt.Snow	No	None	0.86%
30	High	Lt.Snow	PDO-1	Lng.Trm 1	0.00%
Average				Total	100.00%

30 Scenarios

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Microsimulation Overview

- Model individual driver behavior
 - Consider driver characteristics
 - Desired speed, headway, lane, etc.
 - Consider vehicle characteristics
 - Vehicle type: car, truck, bicycle, etc.
 - Performance: acceleration, deceleration, etc.
- Model interactions of vehicles
 - With each other (e.g., car following)
 - With the roadway system (e.g., signals, ITS)

Traffic Considerations- Review

- Traffic has generally grown in recent years
 - However, not uniformly or absolutely
- Need Travel Demand Models for forecasts
 - Based on related factors (e.g., income)
 - Developed at regional scale
- Use traffic engineering principles to adapt for project-level analyses
- Variability at various scales
 - Temporally and spatially
- Use the right tool for the job- model, data

Traffic Considerations- References

Traffic Analysis Tools:

http://ops.fhwa.dot.gov/trafficanalysistools/

Interim Guidance-Travel & Land Use Forecasting in NEPA

http://environment.fhwa.dot.gov/projdev/travel_landUse.asp Guide on Consistent Traffic Analysis:

www.fhwa.dot.gov/publications/research/operations/11064/index.cfm Travel Trends:

www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm Traffic Flow Theory:

www.fhwa.dot.gov/publications/research/operations/tft/index.cfm NCHRP Reports: (http://www.trb.org/Publications/Publications.aspx) 535-Predicting Air Quality Effects of Traffic-Flow Improvements 716-Travel Demand Forecasting: Parameters and Techniques 765-Analytical Travel Forecasting Approaches for Project-Level Planning and Design

Travel Model Improvement Project:

http://www.fhwa.dot.gov/planning/tmip/ Highway Capacity Manual 2010: http://www.hcm2010.org/



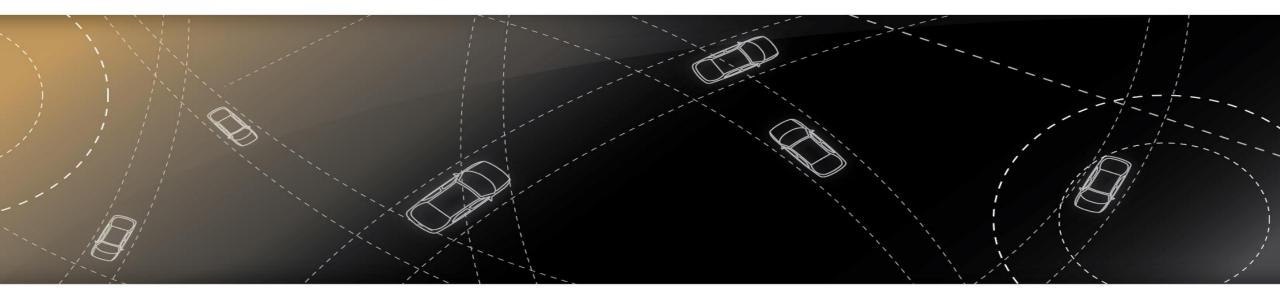
Contact Information:

Paul Heishman, PE

FHWA Resource Center 410-962-2362

paul.heishman@dot.gov

www.fhwa.dot.gov/resourcecenter



Models Used in Air Quality Analysis

Emission Factor Models

Madhusudhan Venugopal

Outline

- Background
- On-Road Emission Estimation Process
- Factors Influencing Emissions Rates
- EPA Approved On-Road Models
- Model Applications, Features, Working Process,
- Modeling Scales
- Input Data and Sources
- Model Output and User Options
- Emissions Modeling
- Resources



Background

Regional Emission Inventories

- On-road
- Point
- Area
- Non-Road
- Biogenic

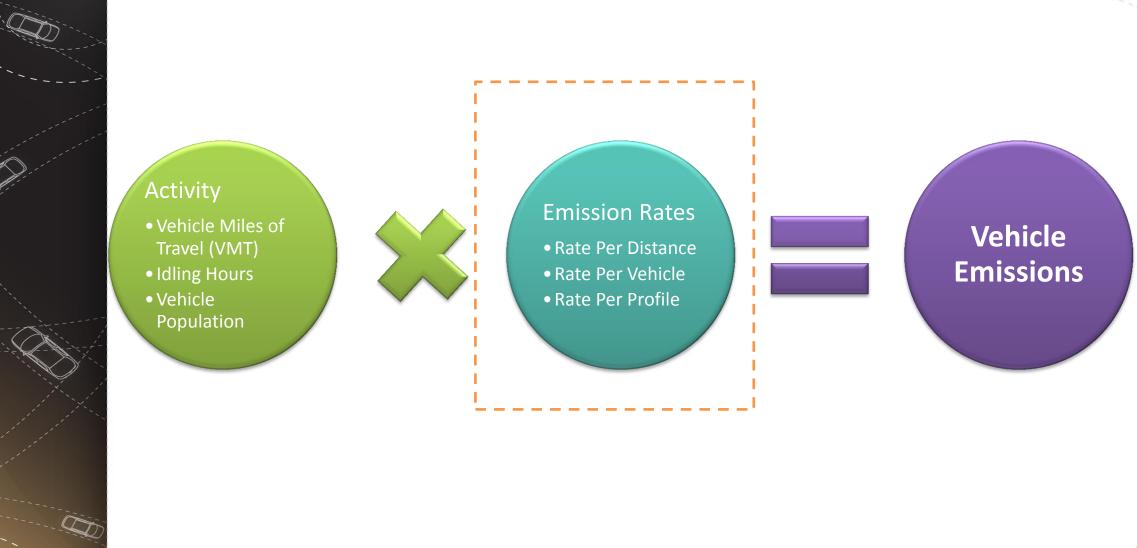


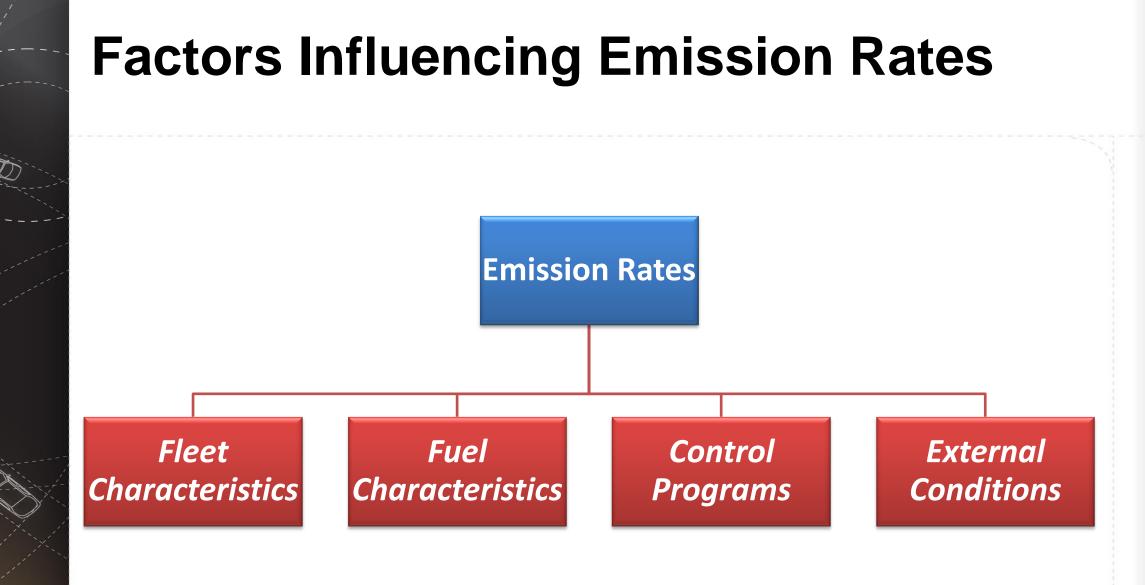
Air Quality Planning



Attainment of Air Quality Standards

On-road Emission Estimation Process





EPA Approved On-Road Models

California

- EMFAC2014, Effective December 14 2015
- Conformity Grace Period December 14, 2017

Outside of California

- MOVES2014/MOVES2014a, Effective October 7, 2014
- Conformity Grace Period October 7, 2016



Model Application

State Implementation Plan (SIP)

- Attainment Demonstration SIP
- Reasonable Further Progress SIP

Regional Transportation Conformity

Project Level Analysis

- Mobile Source Air Toxics
- CO & PM Hotspot

Alternative Scenarios

- Mobility Plan Analysis
- What-if Scenarios

Trend Analysis

Emission Reduction Measure Analysis

- Congestion Mitigation and Air Quality Reporting
- Project Selection (Cost-Effectiveness)



	V MOVES - C:\Users\m-venugopal\Desktop\Sample MOVES Run - ID 5132426149976601720
Structure	File Edit Pre Processing Action Post Processing Tools Settings Help
	Description
 Graphical User Interface (GUI) 	Scale
• Database	Time Spans
 Default or User Supplied Data 	Geographic Bounds
	Vehicles/Equipment Description: Sample MOVES Inventory Run
Scale	Road Type
 National, County, and Project 	Pollutants And Proces
	Manage Input Data Se
Calculation Mode	🛨 🏑 Strategies
	E V Output
 Rate (mass/activity) 	Advanced Performanc
 Inventory (pounds, tons) 	
Time Span	
• 1990, 1999-2050	
 Any or All Months of a Year 	Open an existing RunSpec
י הווי טו הוו ויוטוונווט טן ע וכעו	

8

- Weekday and/or Weekend
- Any or All Hours of a Day

Model Features Cont'd

Emission Processes

• Running, Start, Extended Idle, Evaporative (Permeation, Vapor Venting, Liquid Leaks), Refueling (Vapor loss, Spillage), Crankcase, Tire Wear, Brake Wear

Pollutants

• HC Species, CO, NOx, NH₃, SO₂, PM, CO₂, CH₄, N₂O, 50+ Toxics, Energy

Fuels

• Gasoline, CNG, Diesel, Ethanol (E-85), Electric

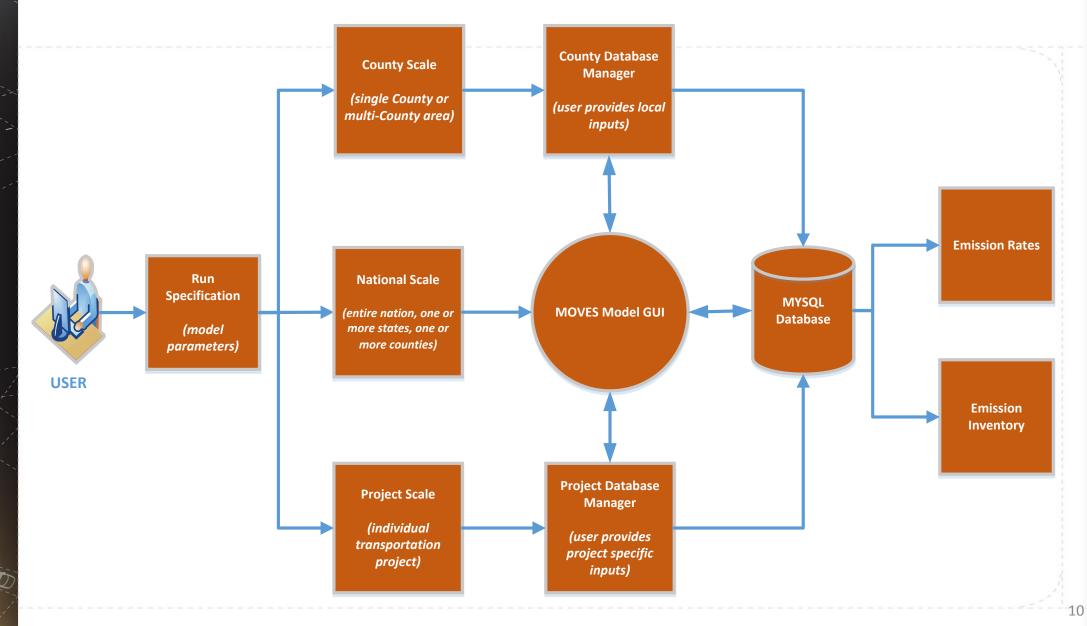
Vehicle Type

• Motorcycle, Passenger Car, Passenger Truck, Light Commercial Truck, Intercity Bus, Transit Bus, School Bus, Refuse Truck, Single Unit Short-haul Truck, Single Unit Long-haul Truck, Motor Home, Combination Short-haul Truck, Combination Long-haul Truck

Roadway Type

- On-network (Rural and Urban Restricted and Unrestricted Access)
- Off-network (Idling, starts, etc.)

Model Working Process



Model Working Process Cont'd

Run Specification File (Runspec)

- Create Single Runspec and Modify Subsequent Ones
- Multiple Runspec Creator in MOVES model

County Data Manager and Project Data Manager

• Can Bypass Using MSQL Queries

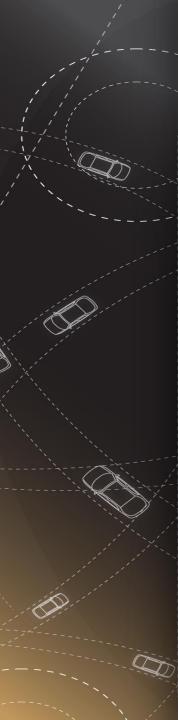
Running Model

- Running Multiple Runspecs in One Instance
- Using Multiple Computers for Single Run
- Invoking Multiple Workers on Same Computer

Output

- Customize Output Using MSQL Queries
- Model Post Processing Tools

Sample MOVES Run - Notepad File Edit Format View Help <runspec version="MOVES2014a-20151201"> <description><![CDATA[Default CO Emission Rate Run]] ></description> <models> <model value="ONROAD"/> </models> <modelscale value="Inv"/> <modeldomain value="NATIONAL"/> <geographicselections> <geographicselection type="COUNTY" key="48141"</pre> description="TEXAS - El Paso County"/> </geographicselections> <timespan> <year key="2040"/> <month id="1"/> <dav id="5"/> <beginhour id="1"/> <endhour id="24"/> <aggregateBy key="Hour"/> </timespan> <onroadvehicleselections> <onroadvehicleselection fueltypeid="2"</pre> fueltypedesc="Diesel Fuel" sourcetypeid="62" sourcetypename="Combination Long-haul Truck"/> <onroadvehicleselection fueltypeid="2"</pre> fueltypedesc="Diesel Fuel" sourcetypeid="61" sourcetypename="Combination Short-haul Truck"/> <onroadvehicleselection fueltypeid="2"</pre> fueltypedesc="Diesel Fuel" sourcetypeid="41" sourcetypename="Intercity



Modeling Scales

National

- Uses Default Data
- Multiple States and Counties
- Both Rate and Inventory Calculations
- Not Recommended for Transportation Conformity and SIP

County

- User can Populate Local Data
- One County or Custom Domain
- Required for Transportation Conformity and SIP
- Both Rate and Inventory Calculations

Project

- Link level Modeling of Transportation Projects
- User can Populate Project Specific Data
- *Required for Quantitative Hot-Spot Analysis*
- Both Rate and Inventory Calculations

Input Data & Sources

Not Necessary to Reinvent the Wheel

- Consult with Interagency Consultation Group
- Focus on Inputs Having Highest Impact on Emissions

Resources

- State Air Agency
- State Department of Transportation
- Metropolitan Planning Organizations
- EPA, join-EPA-MOBILENEWS@lists.epa.gov for model updates and send questions to MOBILE@epa.gov
- Federal Highway Resource center, <u>https://www.fhwa.dot.gov/resourcecenter/teams/airquality/index.cfm</u>

Input Data & Sources for County Scale

Data Type	MOVES Inputs	Rate Mode	Inventory Mode	Sources
Speed Distribution	Avgspeeddistribution	Default/Local	Local	Travel Demand Model
	fuelformulation, fuelsupply,			Regional and National Fuel Surveys,
Fuel	fuelusagefraction, AVFT	Local	Local	Registration Data, Other Proprietary Sources
	Hotellingactivitydistribution			
Hoteling	Hotellinghours	Optional	Optional	Regional Studies and Other Proprietary Sources
	hpmsvtypeyear, hourvmtfraction,			Travel Demand Model, HPMS, Traffic Recording
Vehicle Type VMT	dayvmtfraction, Monthvmtfraction	Dofault/Local	Local	Stations, State DOT's, MPO's
<i>·</i> ·		Default/Local	LUCAI	
Road Type Distribution	roadtunodictribution	Default/Local	Local	Travel Demand Medel Traffic Decording Stations
	roadtypedistribution	•	Local	Travel Demand Model, Traffic Recording Stations
IM Program	imcoverage	Local	Local	State Air Agencies
	Starts, Startshourfraction Startshouradjust, Startsperday Startssourcetypefraction,			
Starts	Importstartsopmodedistribution	Optional	Optional	Regional Studies and Other Proprietary Sources
				Travel Demand Model, HPMS, Traffic Recording
Ramp Fraction	Roadtype	Local	Local	Stations
Age Distribution	sourcetypeagedistribution	Local	Local	Registration Data, Other Proprietary Sources
Source Type				
Population	sourcetypeyear	Default/Local	Local	Registration Data, Other Proprietary Sources
Meteorology Data	zonemonthhour	Local	Local	National or State or Local Weather Agencies
Retrofit Data	onroadretrofit	Optional	Optional	Region Specific Programs

Input Data & Sources for Project Scale

Same as County Scale

• Age Distribution, Meteorology Data, Fuel, Inspection/Maintenance, Hotelling, Retrofit Data

Project Specific Data

- Links, Off-Network, Link Source Types, Operating Mode Distribution, Link Drive Schedules
- Data Sources include Travel Models Output, Local Studies, Project Sponsors

Model Output and User Options

User Options

Activity Output

Rates Output

 Hour, Daily, Portion of the Week, Monthly, Annual
 Model year, Emission Process, Fuel, Road, and Source Use Types

• National, State, County, etc.

 Distance, Source Hours, Hoteling Hours, Population, Starts, etc.

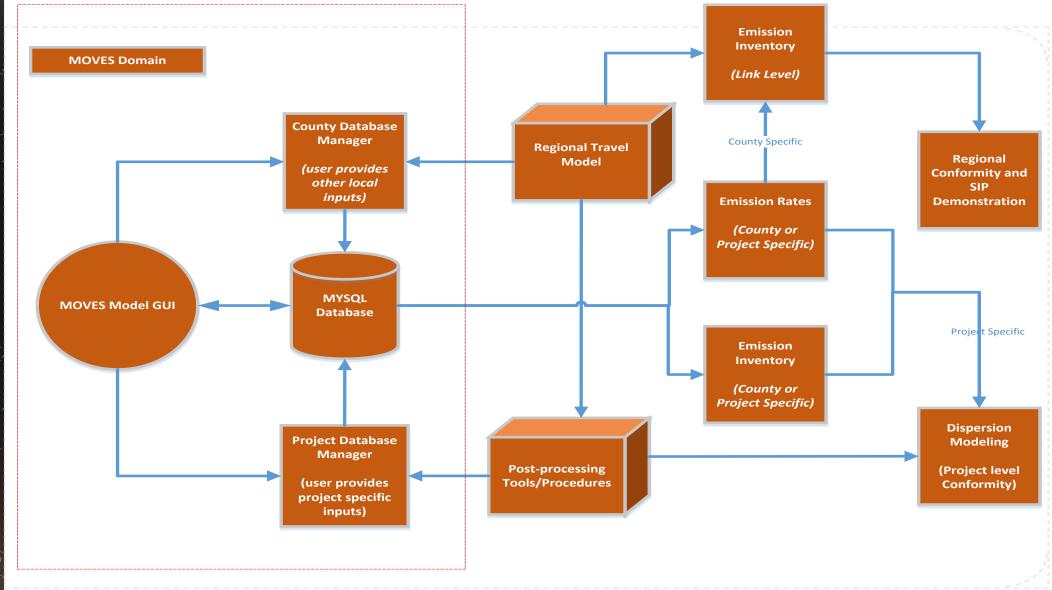
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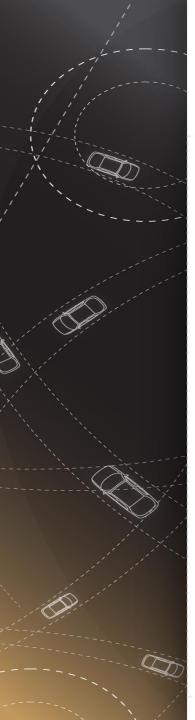
- Rate per Distance
- Rate Per Profile
- Rate per Vehicle
 - Rate Per Hour
 - Rate Per Start

Inventory Output \prec

Emissions Quantity

Emissions Modeling





Take Home Points

Data-Intensive

- Most Critical Inputs
- Inventory Vs. Rate Mode Selection
- MYSQL Queries
- Changing Default Inputs Refer EPA Guidance

Resource-Intensive

- Runtime (Depends on Pollutant-Processes, Mode, Output Options, etc.)
- Inventory Vs. Rate Mode Selection
- Fast Computer & Large Hard-Drive Capacity
- Implement Errors Identification Procedures

Refer EPA Guidance Documents and Training Modules

Resources

EPA, MOVES2014 and MOVES2014a Technical Guidance

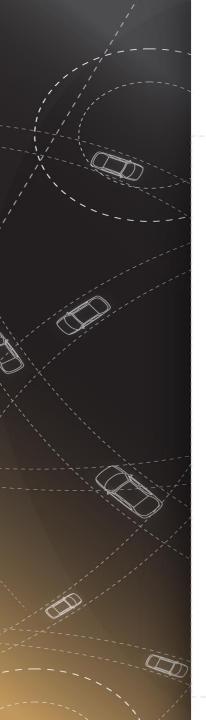
https://www3.epa.gov/otaq/models/moves/index.htm

FHWA, Air Quality Guidance

-<u>https://www.fhwa.dot.gov/environment/air_quality/co</u> nformity/methodologies/moves.cfm

ARB, EMFAC

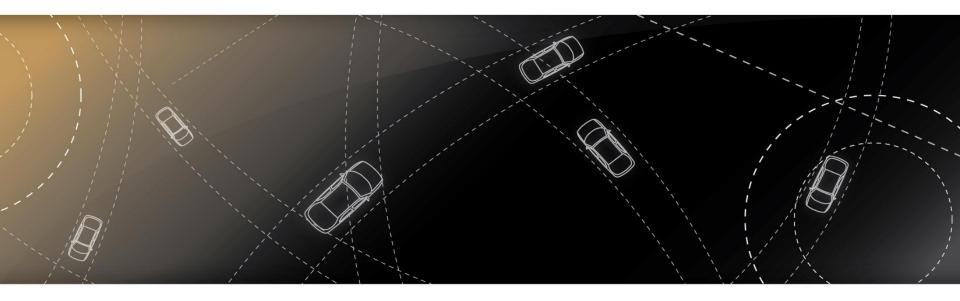
-<u>https://www.arb.ca.gov/msei/categories.htm</u>



Contact

Madhusudhan Venugopal, P.E. Environment and Air Quality Division Texas A&M Transportation Institute Email: <u>m-venugopal@tti.tamu.edu</u> Office: (817) 462-0523 Fax: (817) 461-1239

http://tti.tamu.edu/group/airquality/



Models Used in Air Quality Analysis

Highway Air Dispersion Models

Michael Claggett

Highway Air Dispersion Models

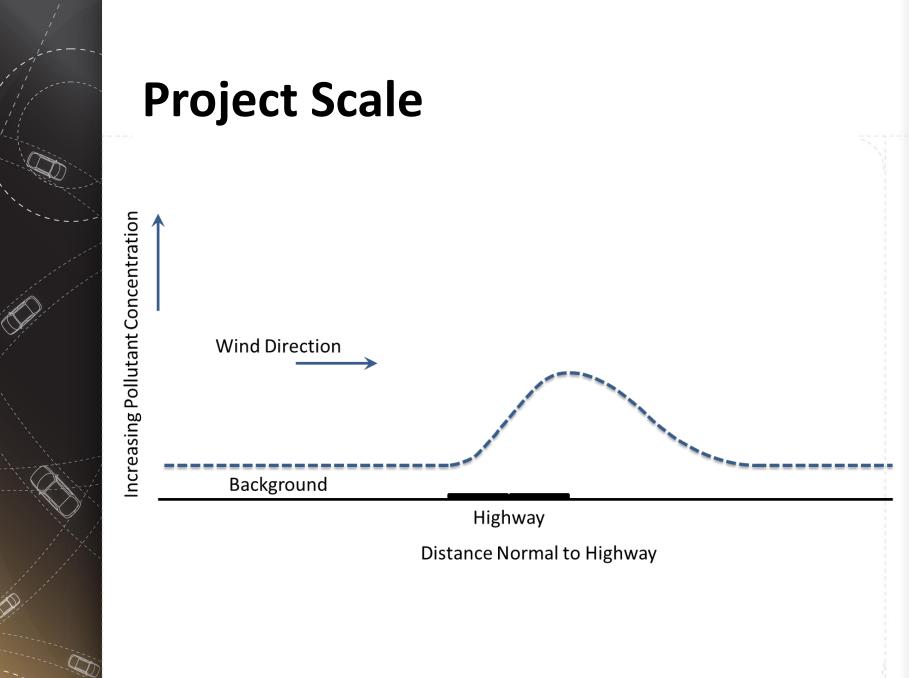
- Review
 - Spatial Regimes
 - Air Quality Model Features
 - Support Center for Air Quality Models
- Plume Dispersion from Highways
- The Gaussian Plume Equation
- Plume Dispersion Patterns
- Summary of Input Data Requirements
- Link / Receptor Configurations

Highway Air Dispersion Models

- Characterizing Atmospheric Stability
- Highway Air Dispersion Model Results
- Analysis Tools
 - Graphical User Interfaces
 - Streamlining the Process / Templates
 - Receptor / Volume Source Spacing Tool
- Dispersion Model Comparison Studies
- EPA's Proposed Replacement of CALINE3 with AERMOD

Spatial Regimes

- Project scale / microscale:
 - Concentrations > \pm 20% for distances \leq 100 m
- Urban scale / mesoscale:
 - Concentrations < ± 20% for distances
 between 100 m and 10,000 m
- Regional scale / macroscale:
 - Concentrations < ± 20% for distances
 > 10,000 m



Highway Air Dispersion Model Features

×		Atn	nospheric Sc	ale	
Feature			Project Scale		
	CALINE3	CAL3QHC	CAL3QHCR	AERMOD	R-LINE
Exposure Scale					
Acute	•	•	•	•	•
Chronic			•	•	•
Source Characterization					
Free-flow Highways	•	•	•	•	ded ory ns
Signalized Intersections		•	•		Not imeno igulat icatio
Transportation Terminals				•	Not ecommended for regulatory applications
Urban Areas					for ap
Pollutant Applicability					
Inert Pollutants	•	•	•	•	•
Reactive Pollutants				NO ₂	
Mathematical Class					
Dispersion / Gaussian	•	•	•	•	•
Photochemical / Numerical					
Receptor					
Statistical, Empirical, Physical					
Level of Sophistication					
Screening					
Refined	•	•	•	•	•

www3.epa.gov/ttn/scram

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SCRAM Home You are here: EPA Home × Support Center for Regulatory Atmospheric Modeling Air Quality Models This website is maintained by EPA's Air Quality Modeling Group (AQMG). The AQMG conducts modeling analyses to support policy and regulatory decisions in the Office of Air and Radiation (OAR) and provides leadership and direction on the full range of air quality models and other mathematical simulation techniques used in assessing control strategies and source impacts. Documentation and guidance for these air quality models can be found on this website, including downloadable computer code, input data, and model processors. Conferences & Workshops This site contains the following sections. Air Quality Models – Provides descriptions and documentation for preferred/recommended models, screening models, and alternative models. Modeling Applications and Tools – Provides more detailed information on modeling analyses AQIG has conducted to support policy and regulatory decisions in OAR is the provides access to EPA developed tools for use in State Implementation Plan (SIP) demonstrations and other air quality modeling assessments. Wodeling Cuidance & Support – Provides current guidance for applying air quality modeling here routed to larify receptor information on modeling analyses AQIG has conducted to support policy and regulatory decisions in OAR modeling Applications and other air quality modeling assessments. 06/04/16 The draft SQ, Model Technical Assistance Document been updated to clarify receptor information of regulatory applications, as well as permit applications for new source reviews including Prevention of Significant Deterioration (PSD) regulations. Included is the immimum umber of years to model. Modeling Cuidance & Support – P	LEARN THE ISSUES SCIEN	CE & TECHNOLOGY	LAWS & REGULATIONS	ABOUT EPA	Ad	vanced Search A-Z Inc	
SQRAM Home Air Quality Models Modeling Applications & Tools Modeling Guidance & Support Meteorological Data & Processors Conferences & Workshops Reports & Journal Articles Related Links Modeling Cuidance & Support Modeling Cuidance & Support Models on dollar and publications at a control strategies and source impacts. Documentation and guidance for these air quality models can be found on this website, including downloadable computer code, input data, and model processors. Conferences & Workshops Reports & Journal Articles Medeling Applications and roces or source review the dolbe PT files on the dolbe are control strategies and source impacts. All controls strategies and source impacts. All controls strategies and source impacts. All control strategies and source impacts. All control strategies and source impacts. All controls strategies and source impacts. All controls strategies and source cuipability. In addition, this site. See EPA's PDF files on industry and outside participants in addition the corregulating agencies. A preliminary agencia is posted for travel planning purposes. A registration and workshop informational website will be available later in September. Modeling Applications and Tools - Provides current guidance for applying air quality models for regulatory applications for both State Implementation Plans (SIP) demonstrations and revisions, as well as permit applications for new source reviews including Prevention of Significant Deterioration (PSD) reguilations. Included in this are are links to	Support Center for	Regulatory At	mospheric Modelii	ng (SCRAM)		🖂 Contact Us 📀 Shar	
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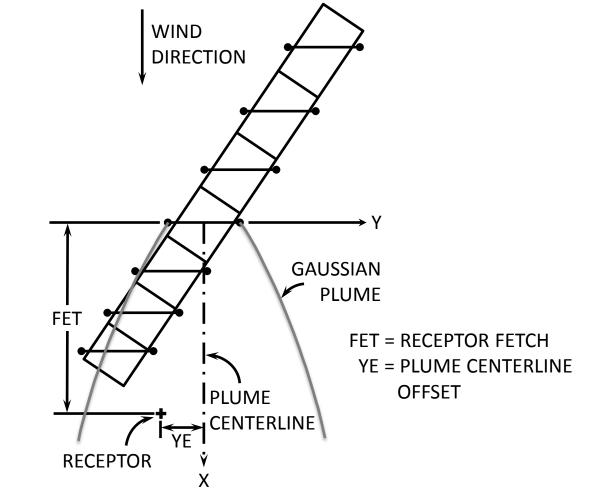
Meteorological Data & Processors - Provides information on Meteorological data used in air quality models as derived from both ambient measurements and meteorological models. Processors based on these two main sources of meteorological data are also provided.

Conferences & Workshops - Provides announcements and related information for

to the MCHISRS database.

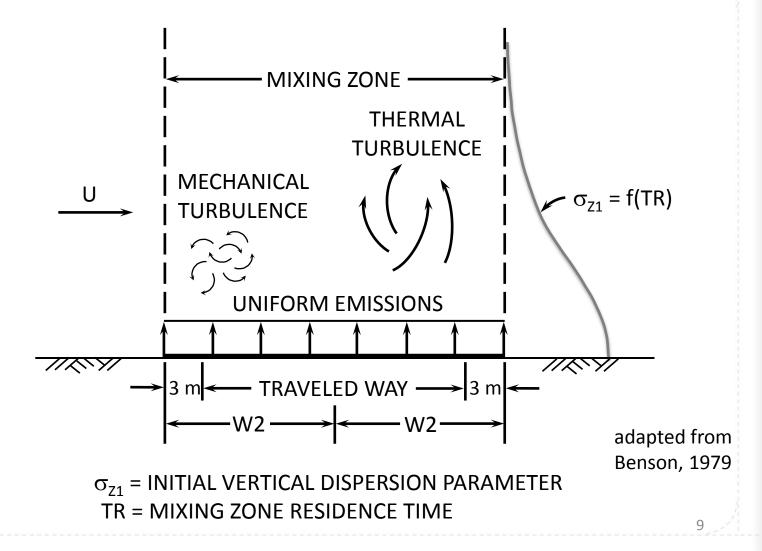
08/01/16 A Model Clearinghouse concurrence memorandum to Region 8 regarding the use of the ADJ_U* beta option in AERMET as an alternative model has been added

Plume Dispersion from Highways – CAL3 Series



adapted from Benson, 1979

Uniform Mixing Zone (CAL3 Series)



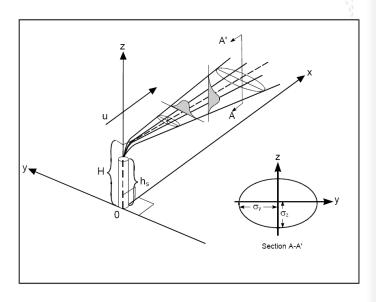
The Gaussian Plume Equation

$$g/m^3 \Delta \frac{g/s}{m/s \times m^2}$$

$$\chi^* = \frac{Q}{u \times \pi \, \sigma_y \, \sigma_z}$$

where

 σ_y is the plume horizontal dispersion coefficient (m) σ_z is the plume vertical dispersion coefficient (m)



*χ is the ground-level concentration on plume centerline due to a ground-level source, typical of a highway

The Gaussian Plume Equation

$$\chi = \frac{Q}{2\pi \, \mathrm{u} \, \sigma_{\mathrm{y}} \, \sigma_{\mathrm{z}}} \exp\left[-\frac{1}{2} \left(\frac{\mathrm{y}}{\sigma_{\mathrm{y}}}\right)^{2}\right] \times$$

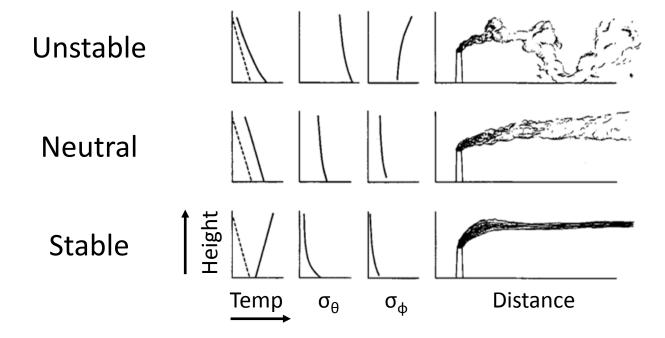
Dilution Crosswind Term Term

$$\begin{cases} \exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_{z}}\right)^{2}\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_{z}}\right)^{2}\right] \end{cases}$$

Vertical
Term
Reflection
Term



Plume Dispersion Patterns



Summary of Input Data Requirements

- Program Controls
 - Run options
 - Output options
- Receptor Locations
 - X and Y location coordinates
 - Height of the breathing zone
- Highway Configurations
 - Source location coordinates
 - Source height
 - Source width

Summary of Input Data Requirements

Vehicle Emissions

- Traffic volume
- Emission factor or rate
- Meteorology
 - Wind speed
 - Wind direction
 - Atmospheric stability measure
 - Mixing height

Link / Receptor Configuration – CAL3 Series

- XL1, YL1 = Link centerline start
- XL2, YL2 = Link centerline end

WI

– XR, YR = Receptor

XL1

YL1

– WL = Mixing zone width



XL2,

YL2

Link / Receptor Configuration – AERMOD Area

vinit

- Xs, Ys = Area source vertex
- Xcoord, Ycoord = Discrete receptor
- Xinit = Length of X side of area
- Yinit = Length of Y side of area
- Angle = Orientation angle
 from north

Angle

Xs,

Ys

Xcoord, Ycoord

Link / Receptor Configuration – AERMOD Line*

- Xs1, Ys1 = Line midpoint start
- XL2, YL2 = Line midpoint end
- Xcoord, Ycoord = Discrete receptor

WI

– W = Highway width

Xs1

Ys1

Xcoord, Ycoord

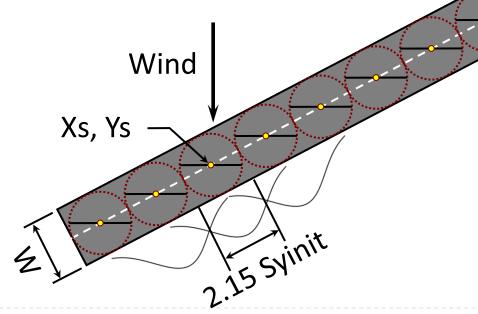
*The AERMOD LINE source type utilizes the same routines as the AERMOD AREA source type, and will give identical results for equivalent source inputs

Xs2,

Ys2

Link / Receptor Configuration – **AERMOD Volume**

- Xs, Ys = Volume source center
- Xcoord, Ycoord = Discrete receptor
- Receptor Exclusion Zone* – W = Highway width; Source spacing
- Syinit = Initial lateral dimension of volume source



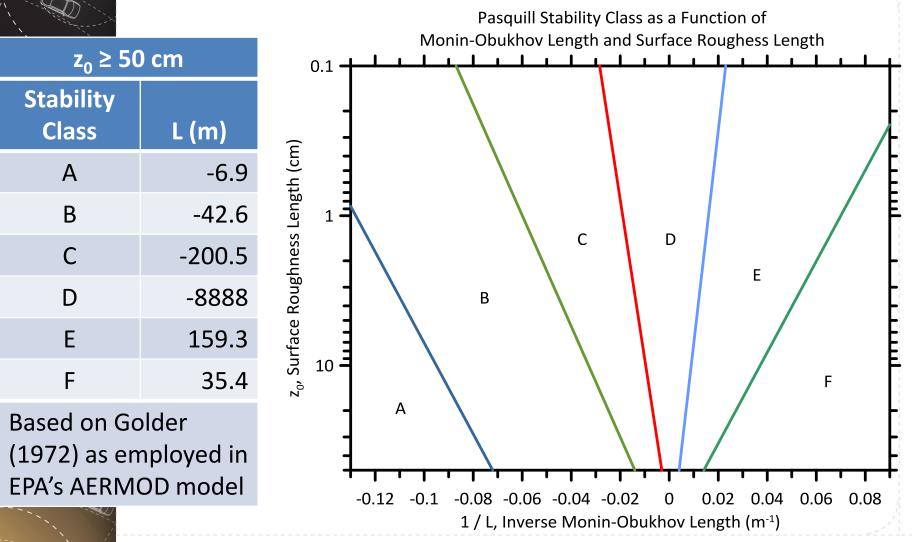
Receptor Exclusion Zone* * within W + 1 m of volume source location

Xcoord, Ycoord

Characterizing Atmospheric Stability – Pasquill's Categories

Surface				Night	ttime			
Wind	Day	time Insolat	tion	Conditions				
Speed				\geq 4/8	≤ 3/8			
(m/s)	Strong	Moderate	Slight	Clouds	Clouds			
< 2	А	A-B	В					
2	A-B	В	С	E	F			
4	В	B-C	С	D	E			
6	С	C-D	D	D	D			
>6	С	D	D	D	D			
A: E	xtremely ι	Instable	D: Neutral					
B: N	/loderately	unstable	E: Slig	E: Slightly stable				
C: S	lightly unst	table	F: Moderately stable					

Characterizing Atmospheric Stability – Obukhov Length

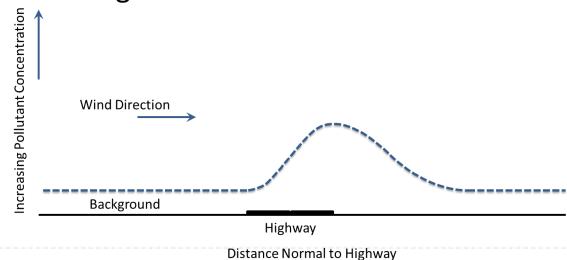


Meteorology Inputs

- Screening Meteorology
 - AERMOD MAKEMET
 - CALINE3 / CAL3QHC specified in EPA Guidance
- Refined Meteorology
 - AERMOD AERMET
 - CAL3QHCR MPRM

Air Quality Model Results

- Project scale
 - Ambient Concentration =
 - Background +
 - Highway Contribution +
 - Other Nearby Sources Not Reflected in Background



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Highway Air Dispersion Model Results

- Compute design values
 - Ambient concentration statistic appropriate for comparison to a National Ambient Air Quality Standard (NAAQS)
 Design Value ≤ NAAQS ?
- NAAQS
 - CO
 - 9 ppm 8-hours not to be exceeded more than once per year
 - 35 ppm 1-hour not to be exceeded more than once per year

Highway Air Dispersion Model Results

NAAQS

- PM2.5
 - 12.0 μg/m³ (2012) annual mean, averaged over 3 years
 - 35 μg/m³ (2012) 24-hours 98th percentile, averaged over 3 years

– PM10

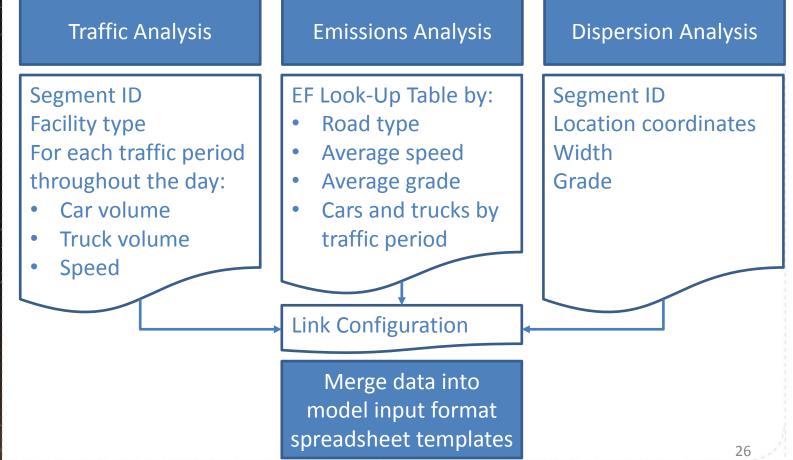
 150 μg/m³ – 24-hours not to be exceeded more than once per year on average over 3 years



- Graphical User Interfaces
 - NCHRP 25-48 TRAQS (under development)
 - Commercial software available from a number of vendors
 - FHWA's CAL3i



Streamlining the Process

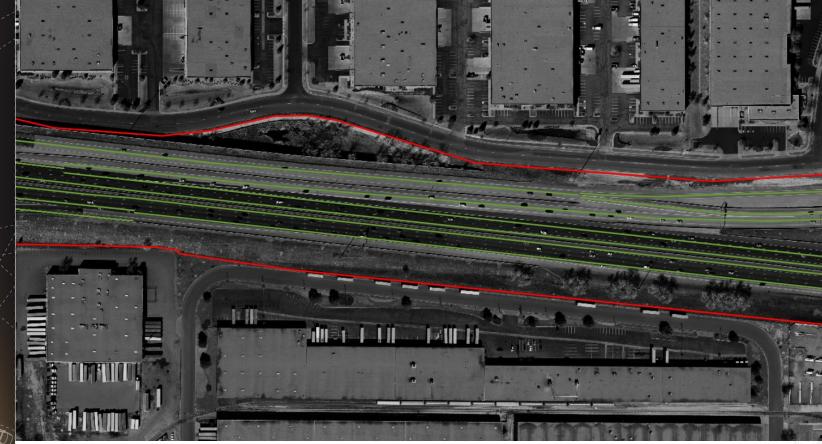


Spreadsheet Templates

		1	1				1			
со	STARTING									
	TITLEONE			kample Arterial						
	TITLETWO	2008-2012 Met	teorology							
	MODELOPT	FLAT CONC								
	AVERTIME	24 ANNUAL								
	URBANOPT	200000								
	POLLUTID	PM2.5								
	FLAGPOLE	1.5								
	RUNORNOT	RUN								
	ERRORFIL	ERRORS.OUT								
CO	FINISHED									
SO	STARTING							RE STARTING		
**				Xs1	Ys1	Xs2	Ys2	**		
**		Scrid	Srctyp	(m)	(m)	(m)	(m)	**	Receptor Arra	V
**								**		- 2
	LOCATION	001	LINE	1899154.559	709066.640	1899156.326	70918	**	Xcoord	Ycoord
	LOCATION	062	LINE	1901374.918	709459.414	1901573.182	70945	6**	(m)	(m)
								**		
**	Line Sour	ce	Lnemis	Relhgt	Width	Szinit		DISCCART	1899132.486	709502.677
**	Parameter	s:	(g/s-m2)	(m)	(m)	(m)		DISCCART	1900976.584	
**								RE FINISHED		
:	SRCPARAM	001	1.0	1.3	7.315	1.2				
	SRCPARAM	062	1.0	1.3	7.315	1.2		ME STARTING		
									23155_2008-20	12 sfc
**	Variable		Qflag	ON	AM1	AM2	ON		23155_2008-20	
**	Emission	Rates:							23155 2008	
	EMISFACT	001	HROFDY	7*2.8228968E-07	6.0721223E-07	5.6048163E-07	2*2.8228968E	UAIRDATA		
	EMISFACT	062	HROFDY	7*5.1687225E-07	1.0886432E-06	1.0034244E-06	2*5.1687225E		0.0	
	URBANSRC	ALL						ME FINISHED	0.0	
	SRCGROUP	ALL								
SO	FINISHED							OU STARTING		
									24 1ST	
								MAXTABLE		
									24 SU 24 ALL PLOT 2	015 EMEAC P
									ANNUAL ALL PL	
								OU FINISHED	ANNUAL ALL PL	.01 2013_EMF
								OU FINISHED		

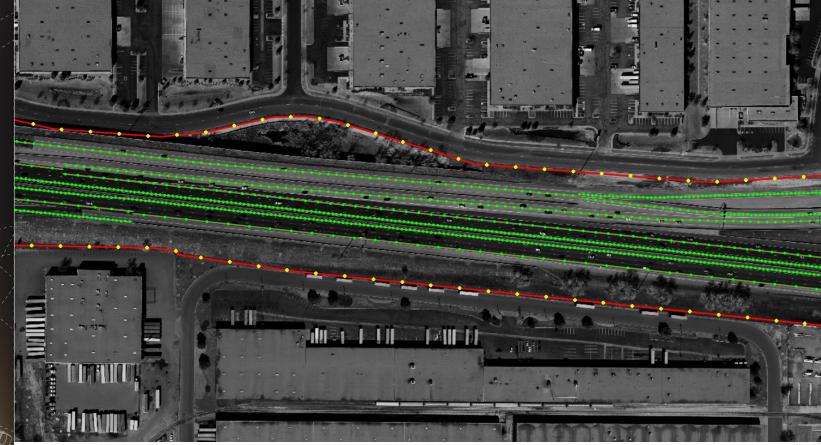


Receptor / Volume Source Spacing





Receptor / Volume Source Spacing



Dispersion Model Comparison Studies

- AERMOD Area versus CAL3QHCR
 - Lin and Vallamsundar (IL DOT study)
 observed 2.1 times higher predictions of annual average concentrations of PM_{2.5}
- AERMOD Volume versus AERMOD Area
 - Schewe reported 1.8 to 3.8 times higher concentration predictions

Highway Air Dispersion Model Comparison Studies

- AERMOD Area versus AERMOD Volume
 - Pasch, et al. (Caltrans study) found that for a hypothetical 1.1 mile freeway widening project
 - AERMOD produced 2.6 times higher concentrations for area sources versus a few (i.e., 22) large volume sources; whereas,
 - the concentration difference was only 10% higher for area sources versus many (i.e., 968) small volume sources

EPA's Proposed Replacement of CALINE3 with AERMOD

- Technical Support Document (TSD) for Replacement of CALINE3 with AERMOD
 - Comparison of CALINE3 and AERMOD
 - Scientific merit of each dispersion model
 - Existing model evaluations
 - Additional testing by EPA

http://www.regulations.gov/#!docketBrowser;r pp=25;po=0;dct=SR%252BO;D=EPA-HQ-OAR-2015-0310

EPA's Proposed Replacement of CALINE3 with AERMOD

- EPA 11th Modeling Conference
 - Presentation by Chris Owen
 - https://remote.dot.gov/ttn/scram/11thmodcon f/presentations/,DanaInfo=www.epa.gov+1-8 CAL3 11th MC.pdf
 - Recommendations for CO screening
 - AERSCREEN (single source) and AERMOD (multiple sources) in conjunction with MAKEMET to generate screening meteorological data based on worst case inputs

Contact Information

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