



# **MOVES Model**

Janice Godfrey

North Carolina Division of Air Quality

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## **New Software Structure**

- **MOBILE6.2** - Written in Fortran, runs in DOS. Many data elements hard-coded (difficult to modify/update).
- **MOVES** - Java/MySQL software.  
Data elements stored in database tables (easy to modify/update).



# More Flexibility

- **MOBILE6.2** - Gram/mile emission factors.  
Fixed output formats
- **MOVES** - Gram/mile emissions factors  
(grams/time for some processes).  
Total emissions: inventories for specific areas  
and time periods.  
Easily customizable output (many levels of  
aggregation/disaggregation possible)



# New Input Requirements

- **Road Type**

- Five different Road Types:

- Off-Network (roadtype 1) – all locations where the predominant activity is vehicle starts, parking and idling (parking lots, truck stops, rest areas, freight or bus terminals)
    - Rural Restricted Access (2) – rural highways that can only be accessed by an on-ramp
    - Rural Unrestricted Access (3) – all other rural roads (arterials, connectors, and local streets)
    - Urban Restricted Access (4) – urban highways that can only be accessed by an on-ramp
    - Urban Unrestricted Access (5) – all other urban roads (arterials, connectors, and local streets)



## **New Input Requirements**

- **Source Type Population Data**
  - Source type (vehicle type) population is used by MOVES to calculate start and evaporative emissions.
  - MOVES categorizes vehicles into 13 source types, which are subsets of 6 HPMS vehicle types in MOVES.
  - MOVES will produce emissions for start and non-running evaporative emissions by source type in terms of grams per vehicle.



## What we currently get:

Vehicle Registrations by County for Year 2009

COUNTY	AUTOS	TRUCKS	BUSES	TRAILERS	MOTOR-CYCLES	MOBILE HOMES	TRACTOR TRUCKS	SPECIAL MBL E Q	WRECKER	REC-(RV) VEHICLES	OTHER	COUNTY TOTAL
ALAMANCE	88,677	28,267	603	15,879	3,182	0	717	15	46	339	17	137,742
ALEXANDER	21,465	10,910	135	6,346	1,247	0	280	5	10	114	11	40,523
ALLEGANY	6,828	4,115	109	1,826	298	1	110	4	5	35	1	13,332
ANSON	13,190	6,126	184	2,860	525	0	295	0	8	20	0	23,208
ASHE	16,081	9,342	172	4,447	755	1	187	5	13	101	1	31,105
AVERY	10,454	5,803	124	2,148	489	0	184	1	2	84	0	19,289
BEAUFORT	27,907	13,039	233	10,201	1,059	9	460	11	28	180	16	53,143
BERTIE	12,109	5,233	237	3,094	338	0	184	1	10	37	1	21,244
BLADEN	18,609	9,268	157	3,510	659	1	301	3	19	91	10	32,628
BRUNSWICK	64,418	21,962	356	11,795	2,981	1	446	29	26	443	548	103,005
BUNCOMBE	138,112	44,123	907	18,660	6,302	3	711	34	55	761	8	209,676
BURKE	50,546	21,768	294	11,274	2,219	2	424	18	31	268	5	86,849
CABARRUS	101,798	31,532	701	16,555	4,680	4	1,211	20	30	420	10	156,961
CALDWELL	46,743	21,236	305	12,115	2,115	2	852	24	27	290	2	83,711
CAMDEN	5,920	2,950	71	2,029	382	0	98	3	3	46	2	11,504
CARTERET	40,389	16,206	280	13,410	2,049	3	120	11	20	408	49	72,945
CASWELL	14,028	7,036	167	2,504	499	0	55	3	5	70	2	24,369
CATAWBA	95,373	33,469	589	22,868	4,314	1	1,820	28	50	524	23	159,059
CHATHAM	39,818	14,615	330	8,416	1,483	2	375	25	34	177	5	65,280
CHEROKEE	14,613	8,660	175	3,530	886	1	60	10	3	125	1	28,064
CHOWAN	8,353	3,888	114	2,791	225	2	174	3	5	54	1	15,610
CLAY	5,862	3,323	48	1,721	307	1	22	5	0	69	0	11,358
CLEVELAND	54,539	24,100	459	9,572	2,466	3	472	17	33	300	2	91,963



## What we need:

<b>MOVES Source Types and HPMS Vehicle Types</b>			
Source Type ID	Source Types	HPMS Vehicle Type ID	HPMS Vehicle Type
11	Motorcycle	10	Motorcycles
21	Passenger Car	20	Passenger Cars
31	Passenger Truck	30	Other 2 axle-4 tire vehicles
32	Light Commercial Truck	30	Other 2 axle-4 tire vehicles
41	Intercity Bus	40	Buses
42	Transit Bus	40	Buses
43	School Bus	40	Buses
51	Refuse Truck	50	Single Unit Trucks
52	Single Unit Short-haul Truck	50	Single Unit Trucks
53	Single Unit Long-haul Truck	50	Single Unit Trucks
54	Motor Home	50	Single Unit Trucks
61	Combination Short-haul Truck	60	Combination Trucks
62	Combination Long-haul Truck	60	Combination Trucks



# Speed Inputs

- **MOBILE6.2** - rates based on aggregate driving cycles.
- **MOVES** rates based on “operating modes”. Second-by-second activity is captured by the model.





# Average Speed

- EPA expects states to develop and use local estimates of average speed. The Average Speed Distribution importer in MOVES calls for a speed distribution in VHT in 16 speed bins, by each road type, source type, and hour of the day included in the analysis.
- EPA urges users to develop the most detailed local speed information that is reasonable to obtain.



## MOVES - 16 Speed bins

estimate of emissions than use of a single average speed. Table 3.6  
MOVES Speed Bins

Speed Bin ID	Average Bin Speed	Speed Bin Range
1	2.5	speed < 2.5mph
2	5	2.5mph <= speed < 7.5mph
3	10	7.5mph <= speed < 12.5mph
4	15	12.5mph <= speed < 17.5mph
5	20	17.5mph <= speed < 22.5mph
6	25	22.5mph <= speed < 27.5mph
7	30	27.5mph <= speed < 32.5mph
8	35	32.5mph <= speed < 37.5mph
9	40	37.5mph <= speed < 42.5mph
10	45	42.5mph <= speed < 47.5mph
11	50	47.5mph <= speed < 52.5mph
12	55	52.5mph <= speed < 57.5mph
13	60	57.5mph <= speed < 62.5mph
14	65	62.5mph <= speed < 67.5mph
15	70	67.5mph <= speed < 72.5mph
16	75	72.5mph <= speed



# Vehicle Miles Traveled (VMT) Inputs

- EPA expects states to develop local VMT estimates for SIPs and regional conformity analyses.
- As input, MOVES requires annual VMT by HPMS vehicle class.
- EPA has also created a set of software tools that can import VMT tables by MOBILE6.2 vehicle and facility types, as well as MOBILE6.2 hourly VMT fractions, VMT mix, and ramp fractions and convert these to the equivalent MOVES tables of VMT by HPMS class, VMT fractions by hour, and road type distribution.



# What It Means

- Higher NO<sub>x</sub> and PM emissions mean mobile sources have bigger role in attainment.
- Percent reduction from base year is key to attainment analysis.
  - PM<sub>2.5</sub> shows higher overall emissions and higher % reductions. Effect on attainment demonstrations could be positive.
  - NO<sub>x</sub> shows higher overall emissions but lower % reduction. Harder to show attainment. Future NO<sub>x</sub> control measures will have a bigger impact.
- States may need to redo some motor vehicle emissions budgets to meet conformity requirements with MOVES



# Questions ??

## Contact Information

- Janice Godfrey

(919) 715-7647

Janice.Godfrey@ncmail.net