Estimating Vehicle Activity on Unpaved Roads for PM_{10} Conformity

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Overview

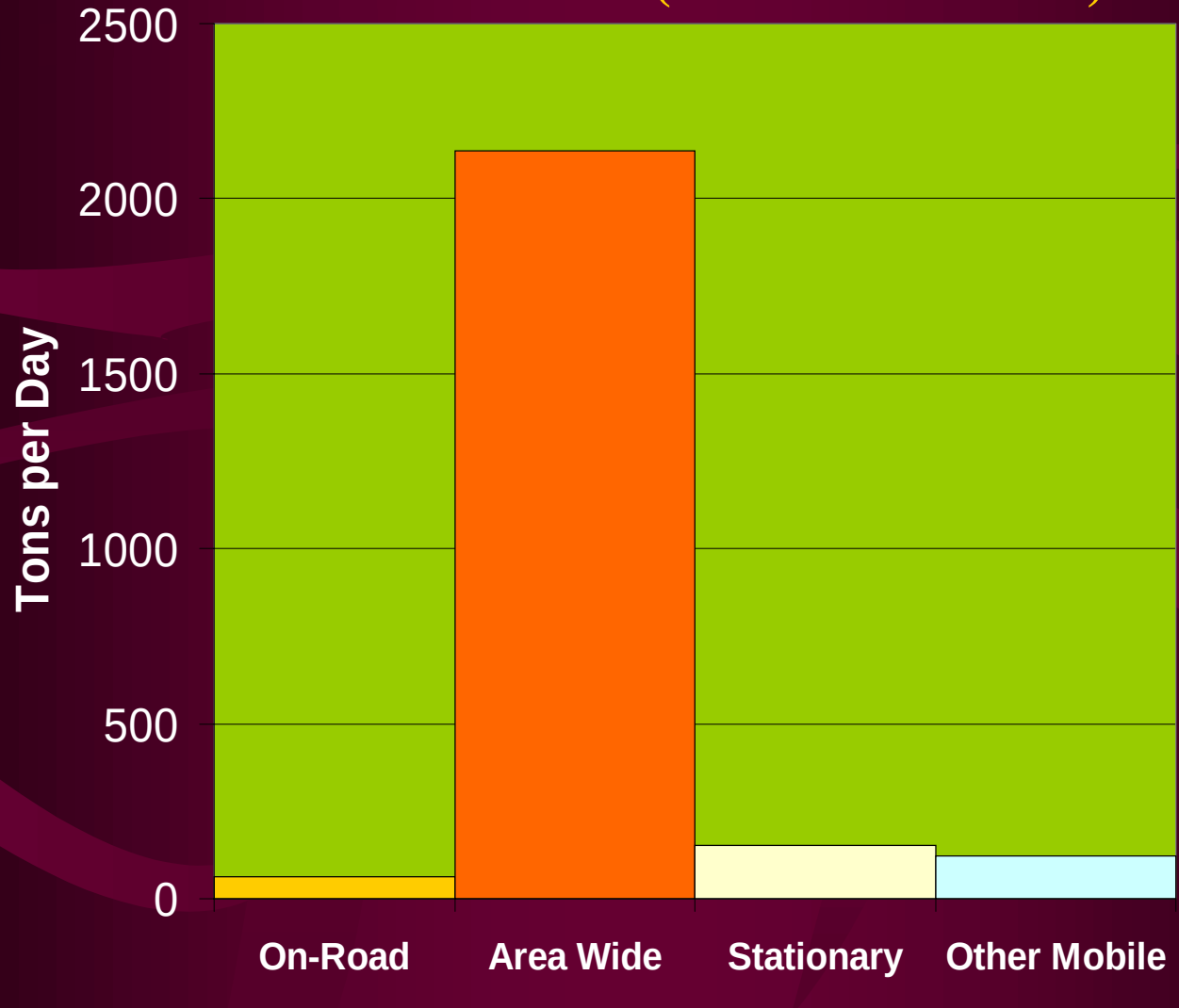
- Background
- Current Method
- Objectives of Research
- Research Approach
- Modeling Procedures and Plans
- Pilot Study
- Research Status and Future Directions

Background

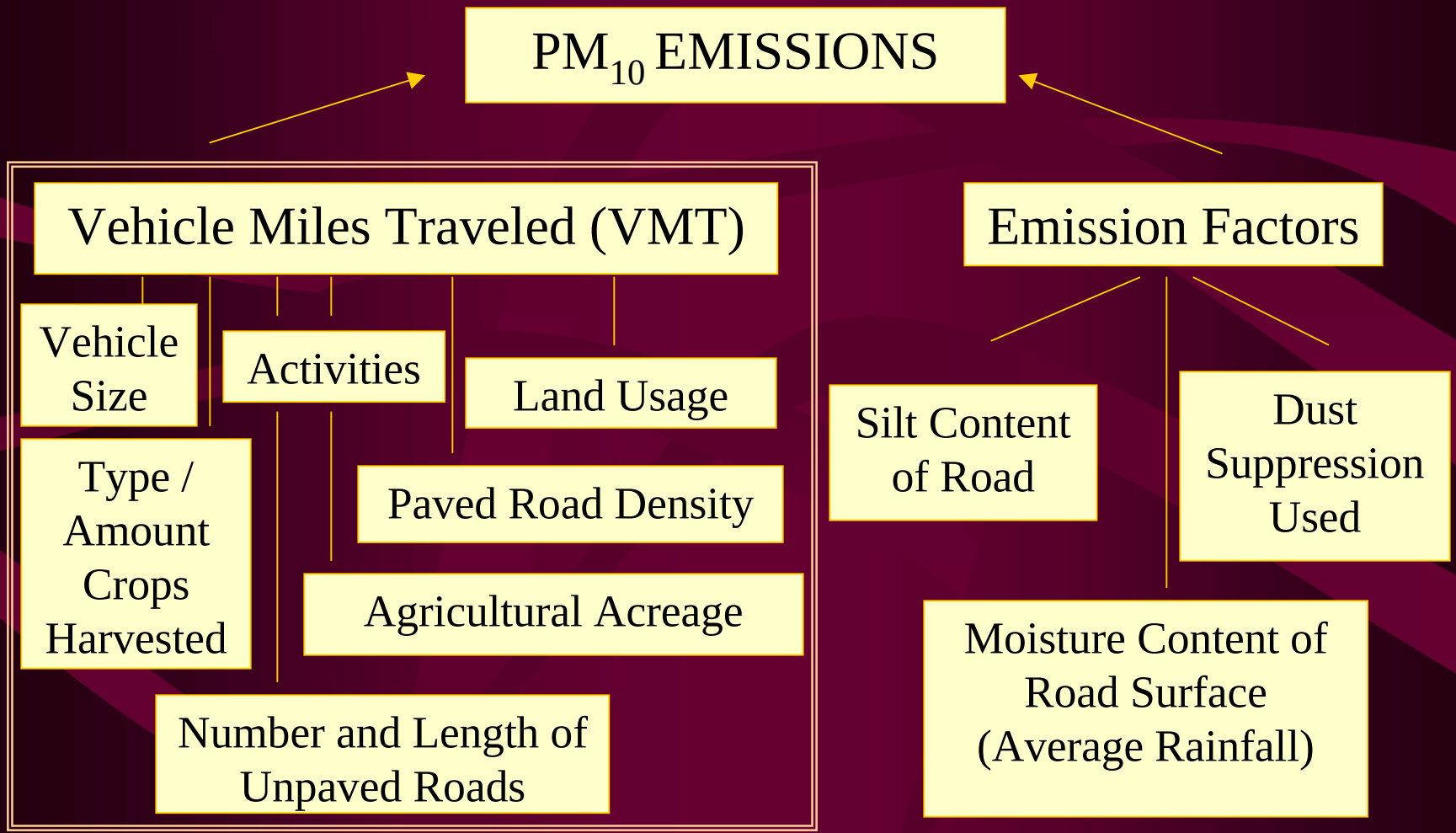
- California's PM_{10}
  - Attainment Status
  - Sources of PM_{10} Emissions

California's PM_{10} Attainment Status (*Source:* CARB 2001)

Sources of PM Emissions in California (*Source*: CARB 2000)



Role of Unpaved Road VMT



Current Method

- PM_{10} Emissions from Unpaved Roads
  - Emission Factor
  - Activity Factor (VMT)
- Daily VMT = 10 x Miles of Unpaved Road
  - No Method for Updating

Objectives of Research

- Framework for Estimating PM_{10} from Unpaved Roads in California
  - Facility Level (*e.g.*, farm, recreation area)
  - Grid Level (*e.g.*, TRS)
  - County Level
  - State Level
- Estimate Statewide PM_{10} Contributions from Unpaved Roads

Research Approach

- Methodological Framework
  - Harvest Model
  - Non-Harvest Model

Overview of Harvest Modeling Procedure

Land-use characteristics
(independent variables)
GIS databases and Lists of Growers.

Annual VMT/Acre
(dependent variable)
Surveys of 7 Counties

Model 1: Logit Model
Purpose: To Estimate the Proportion of Growers with Harvest VMT > 0

Model 2: Regression Model
Purpose: To Estimate VMT on Unpaved Roads per Acre of Farmland

Final Output:
Annual harvest VMT/Acre

Harvest Model

$$P_n(i) = \frac{1}{1 + e^{-\beta' x_n}}$$

$P_n(i)$ = proportion of growers in a given location that have harvest VMT > 0

X_n = vector of observed land-use and spatial variables

β' = vector of estimated coefficients on the observed variables

Land Uses:
Agriculture, Pasture, Urban, Semiagricultural, Residential, Commercial, Industrial, Natural

Spatial Variable:
Density of paved roads

Harvest Model (cont.)

$$\ln(y) = \sum_{k=1}^{K} \beta_k X_k + \sum_{j=1}^{10} \beta_j X_j$$

y = the estimated unpaved road VMT/acre
X_k = a binary indicator denoting each crop type *k*
β_k = the estimated constants for each crop type *k*
X_j = average proportion of land-use *j* calculated for a given TRS location
β_j = the estimated coefficients on land-use *j*.

Harvest Data

- Land Use Data (GIS)
  - CA Department of Water Resources
  - Proportions of Land Use by TRS Location
- Public Land Survey System (PLSS) (GIS)
- List of Growers
  - County Agricultural Commissioners
- Road Coverage (GIS)
  - Paved Road Density

Harvest Data and Sampling Plan

- Survey of Growers
  - Acreage of the grower's typical field
  - Average annual yield from the field
  - Vehicle types used to haul crops from the field
  - Distance from typical pick-up point to nearest paved road
  - Typical beginning and end of the grower's harvest season
- Counties
  - Fresno, Glenn, Merced, Monterey, Santa Barbara, Santa Cruz, Tulare

Harvest Data and Sampling Plan (cont.)

Crop Categories

Group	Category	Crops
1	Field (S)	Beans, Corn (Grain), Cotton, Oats, Rice, Potatoes (Sweet), Wheat (All)
2	Field (M)	Barley, Hay/Alfalfa, Sugar Beets
3	Field (L)	Potatoes
4	Fruit (S)	Apples, Apricots, Boysenberries, Cherries, Dates, Figs, Grapes, Nectarines, Peaches (All), Pears (All), Plums (All)
5	Fruit (M)	Olives, Raspberries, Tangerines, Kiwifruit
6	Fruit (L)	Avocados, Grapefruit (All), Lemons, Oranges, Strawberries
7	Vege (M)	Asparagus, Beans (Snap), Brussels Sprouts, Corn (Fresh), Cucumbers (All), Garlic, Cantaloupe, Honeydew, Watermelon, Onions, Peppers (Bell), Tomatoes (All)
8	Vege (L)	Artichoke, Broccoli, Cabbage, Carrots, Cauliflower, Celery, Lettuce (All), Mushrooms, Spinach
9	Nut	Almonds, Pecans, Pistachios, Walnuts
10	Nursery	Nursery Products, Flowers/Foliage

Overview of Non-Harvest Modeling Procedure

Land-use characteristics
(independent variables)
GIS databases.

Daily traffic counts
(dependent variable)
Traffic counters in specified areas.

Model 3: Regression Model
Purpose: To estimate daily traffic counts on unpaved roads.

(Output from Model 3) x (Miles of unpaved road)

Final Output:
Non-harvest VMT

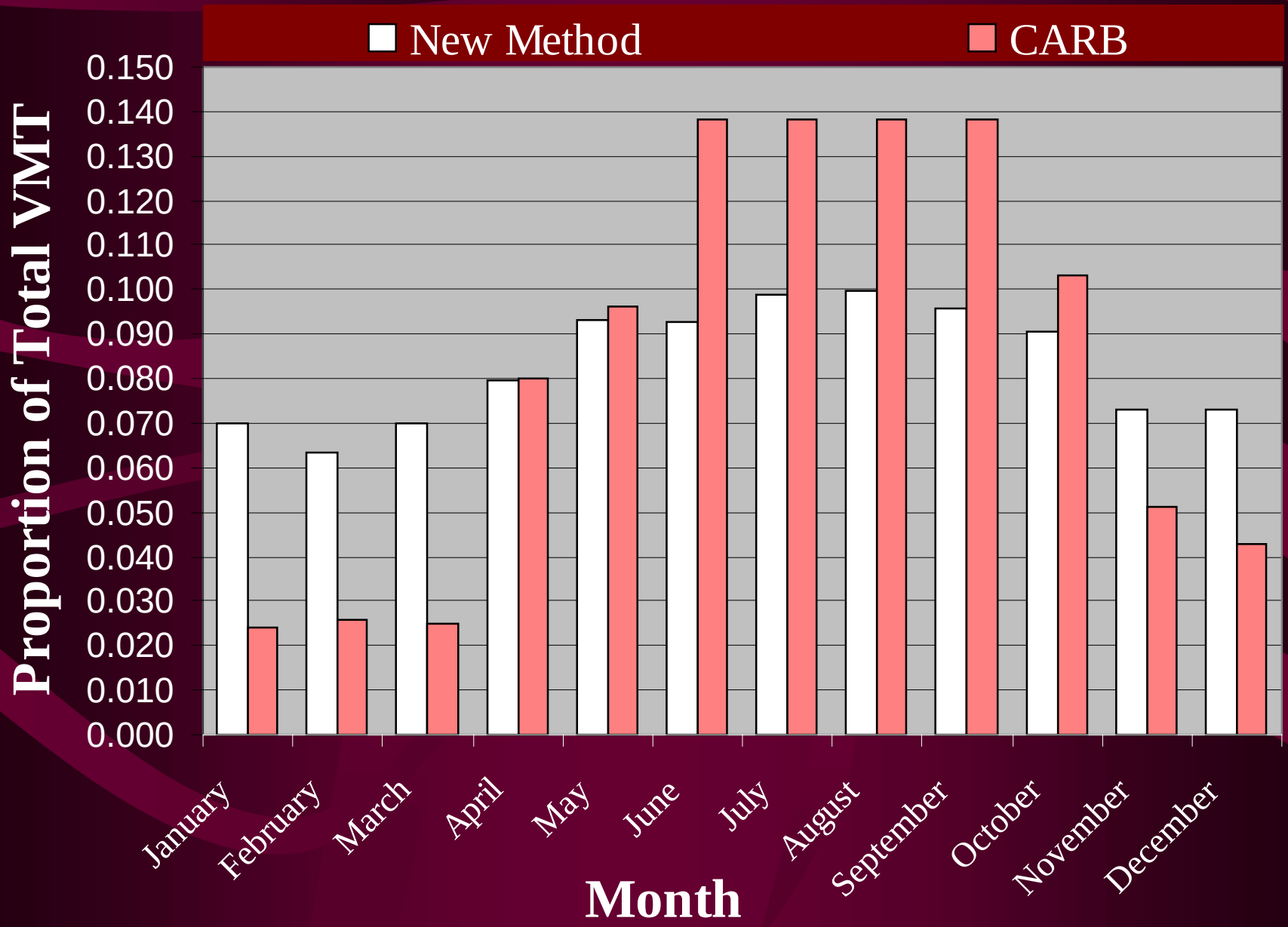
Non-Harvest Data

- Traffic counts (automated counters)
- Land use factors (GIS)
- Spatial factors (GIS)
- Government ownership (GIS)
- Size of recreation area (GIS)
- Activity types

Pilot Study

- Empirical Setting
- Harvest Models
- Non-Harvest Model
- Results
  - 29% less in San Joaquin County
  - 40% less in Fresno County

Pilot Study Results



Research Status and Future Directions

- Harvest Data Collection in Progress
- Non-Harvest Data Collection in Planning Phase

Sources

- California Air Resources Board (CARB). 2001. “Area Designations Maps / State and National.” http://www.arb.ca.gov/desg/adm/adm.htm (slides 8, 3). Last updated: February 15, 2001.
- California Air Resources Board (CARB) 2000. “Public Meeting to Consider Revisions to the State’s On-Road Mobile Source Emissions Inventory.” May 25, 2000.