

Fuel-Based Mobile Source Emissions Inventory Methods

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A SMART SIGN

Provides emissions information for voluntary repairs and for fuel based emissions inventory.

Corpus Christi will have one soon.



YOUR CAR'S HEALTH

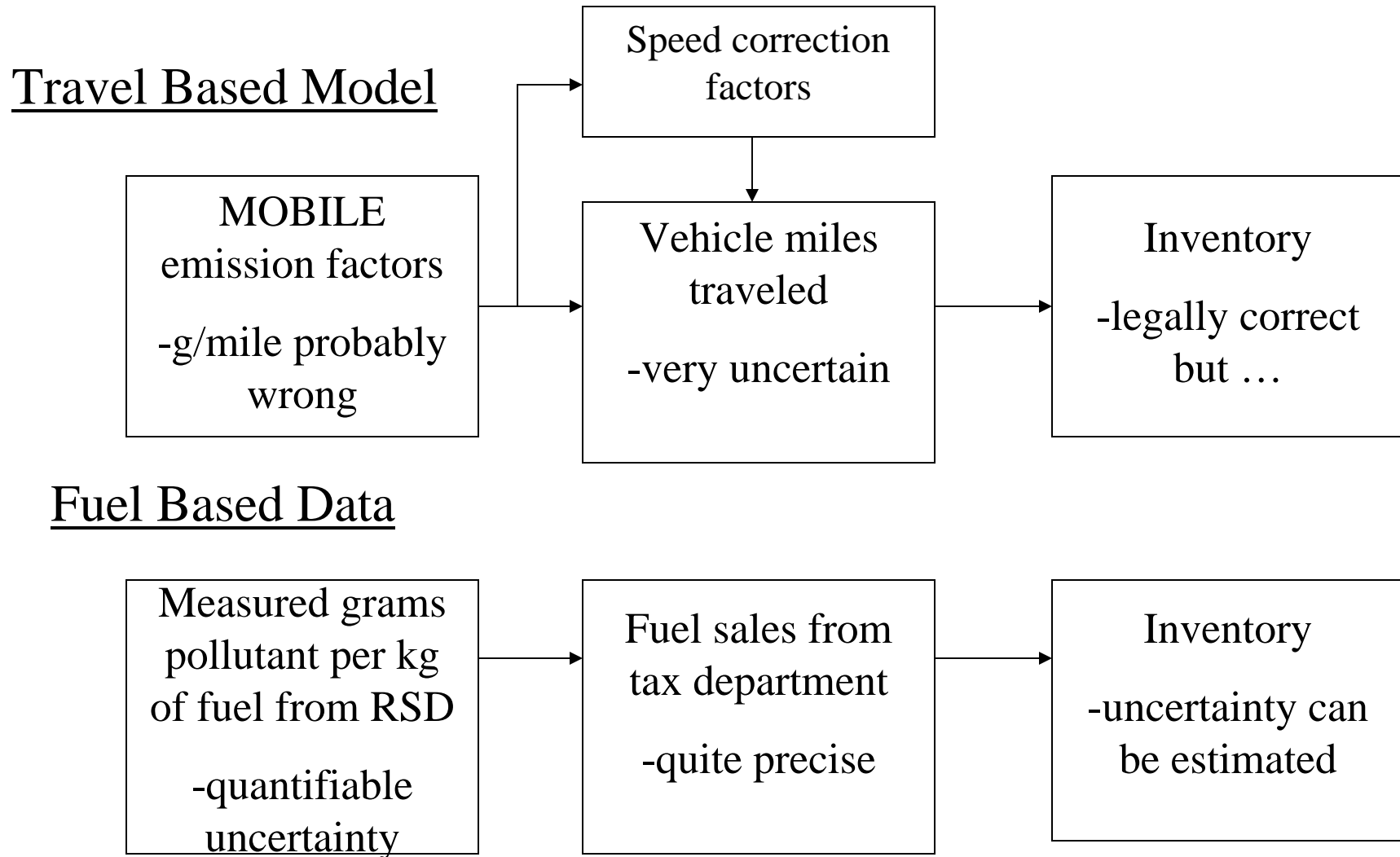
GOOD

SAVING YOU MONEY!

03-871-7777
www.sign.du.edu

Home Inn

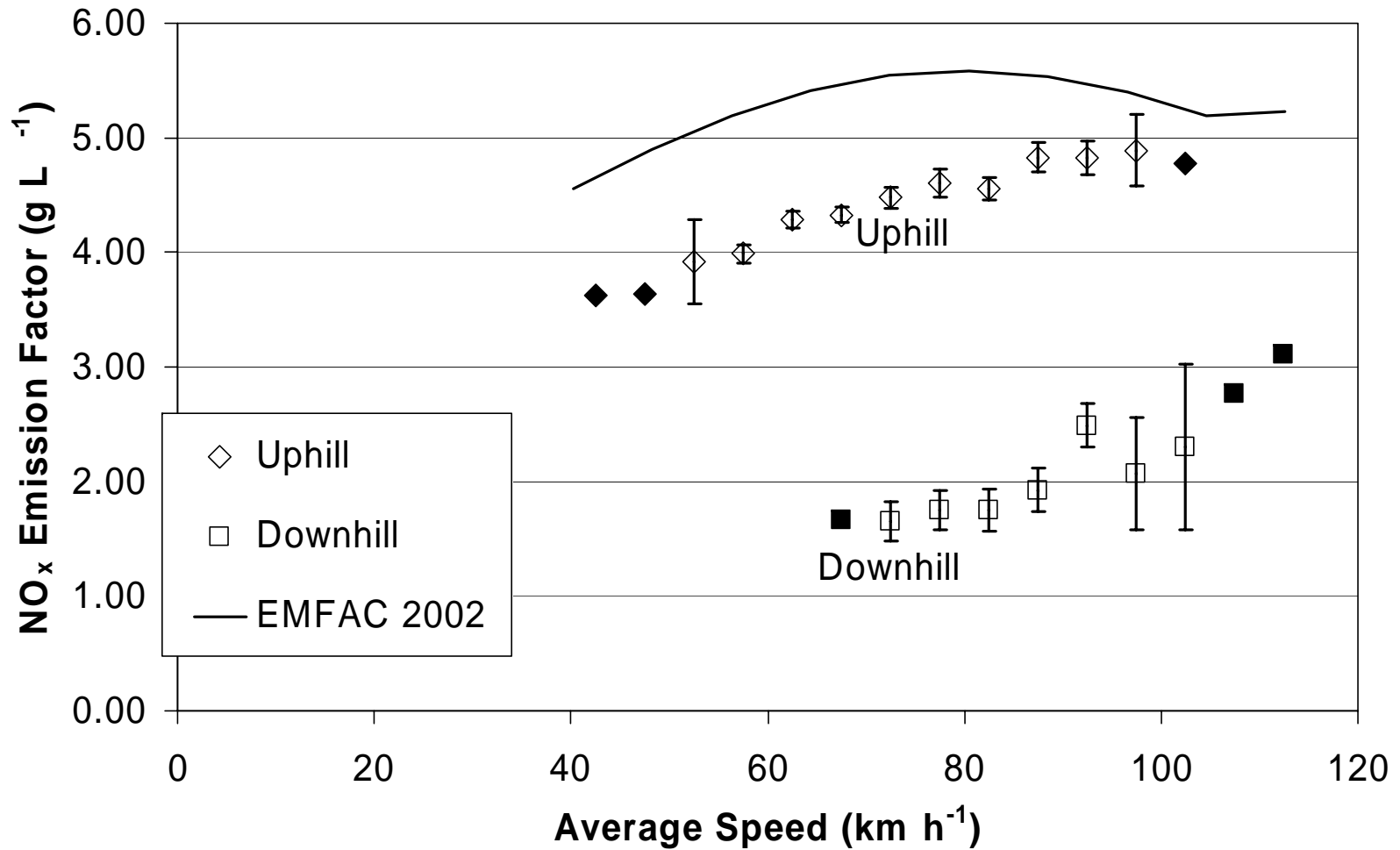
Mobile Source Emissions Inventory Methods



Model vs Measure

- Model MOBILE
- Legally correct
- No uncertainty
- Very likely wrong
- On-road Remote Sensing
- Mass Emissions per gallon of fuel
- Need to go from State to local fuel data by census or DMV
- Quantified uncertainty

Model wrong compared to data in California



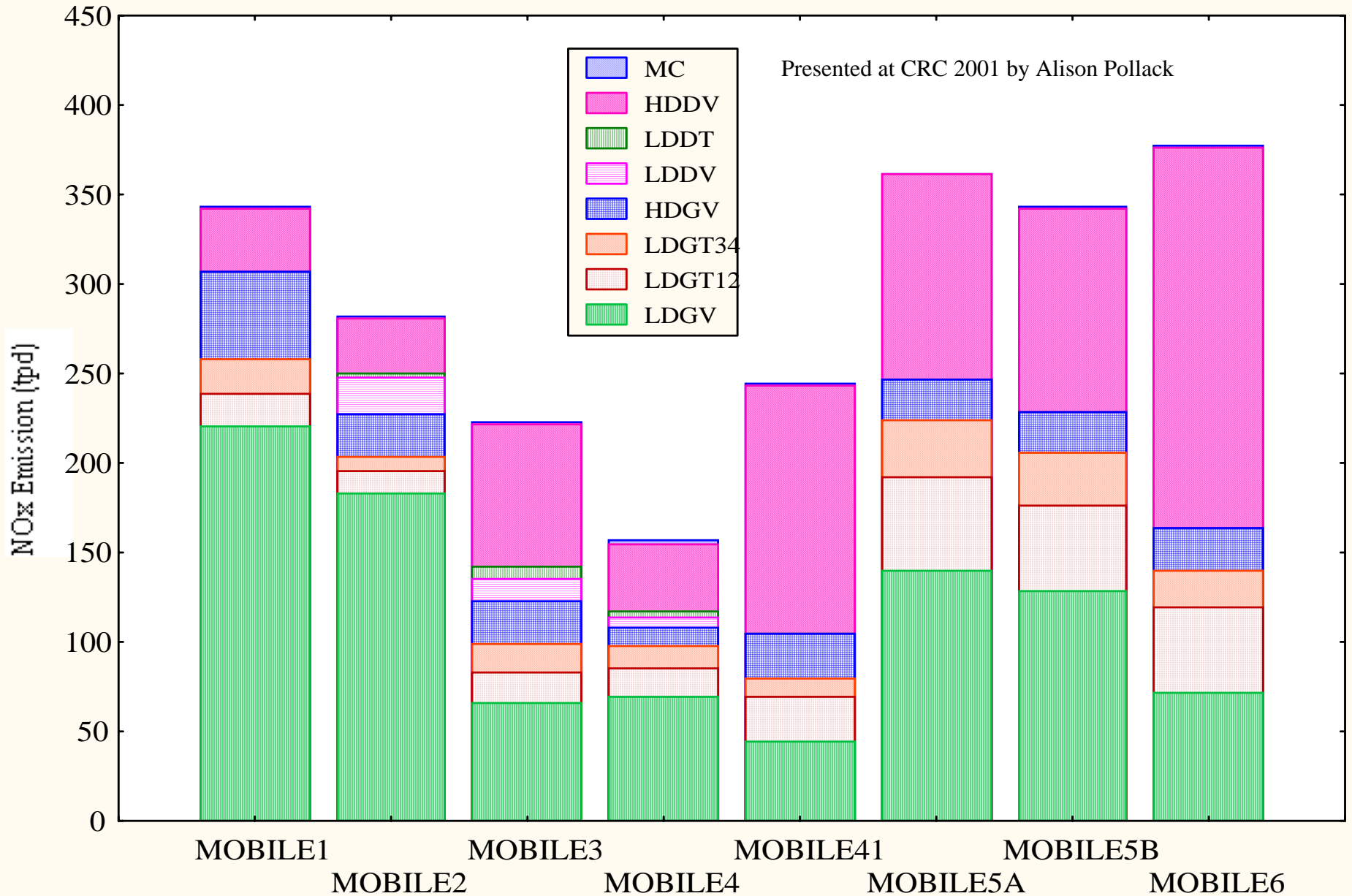
Kean et al. Env. Sci Tech., 37,3739-3746,2003.

DO NOT REMOVE NEGATIVE RSD READINGS FROM YOUR DATA SET

- It is **WRONG** to do so
- Vehicles with zero emissions should deliver an equal number of negative and positive readings
- Negative readings set to zero give them emissions they do not have

2000 NO_x Emissions by Vehicle Class for a Metropolitan Area

(default VMT mix and applicable standards)



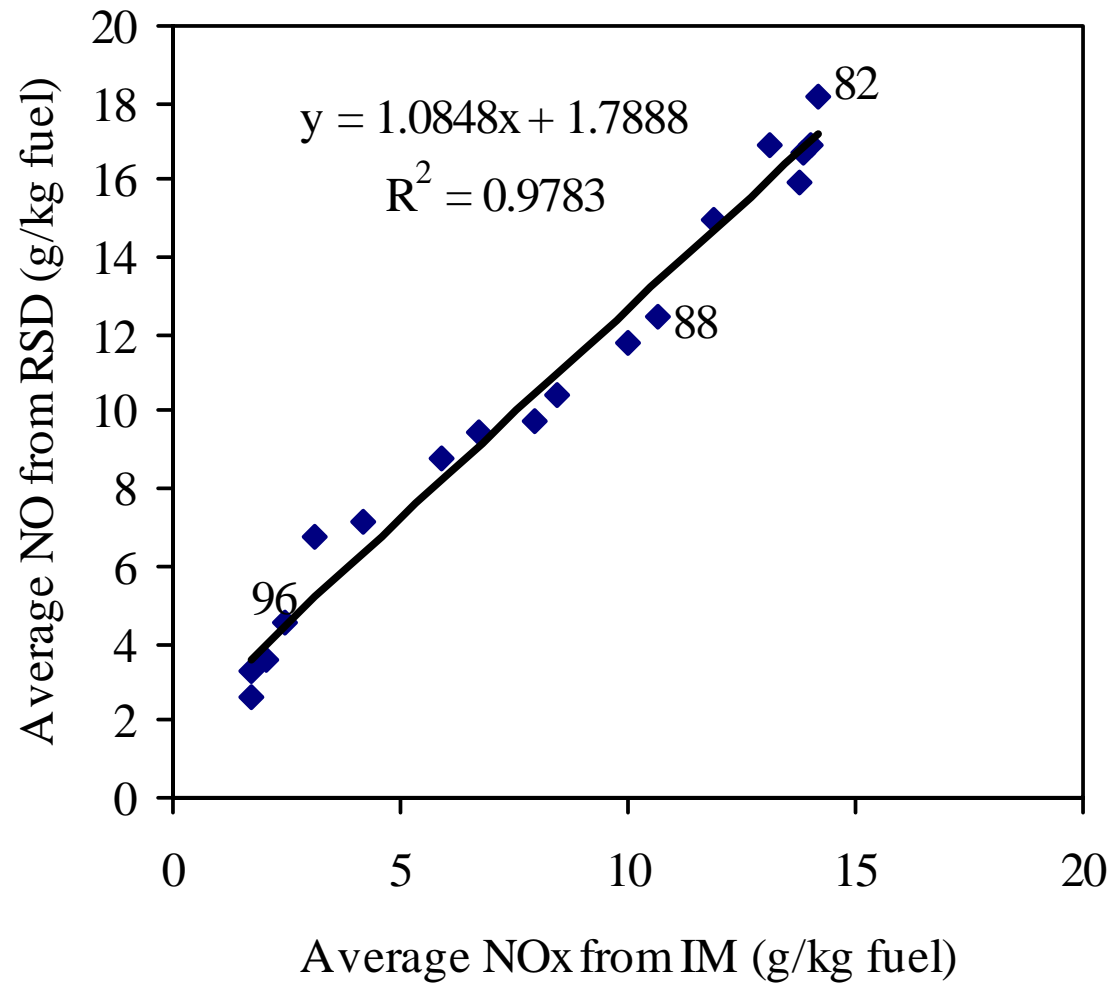
Remote Sensing versus IM240

Correlation in grams/kg

- Data averaged by model year correlate very well
- Cost of RSD: \$25,000
- Cost of IM240: \$25,000,000

Presented at CRC 2000, S. Pokharel et al

Denver 1999 NO



Calculations for Fuel-Based Approach

$$\frac{gCO}{kgFUEL} = \frac{28 \times \frac{\%CO}{\%CO_2}}{\frac{\%CO}{\%CO_2} + 1 + (6 \times \frac{\%HC}{\%CO_2})} \times \left(\frac{1}{0.014}\right)$$

$$\frac{gHC}{kgFUEL} = \frac{88 \times \frac{\%HC}{\%CO_2}}{\frac{\%CO}{\%CO_2} + 1 + (6 \times \frac{\%HC}{\%CO_2})} \times \left(\frac{1}{0.014}\right)$$

$$\frac{gNO}{kgFUEL} = \frac{30 \times \frac{\%NO}{\%CO_2}}{\frac{\%CO}{\%CO_2} + 1 + (6 \times \frac{\%HC}{\%CO_2})} \times \left(\frac{1}{0.014}\right)$$

Calculations of Emission Factors in Fuel-Based Approach

$$t_{yv} = \frac{n_{yv}}{N}$$

y = model year subgroup
 v = vehicle type subgroup (car or truck)
 t = fraction of travel of subgroup
 n = number of measurements of subgroup
 N = total number of measurements

$$f_{yv} = \frac{(t_{yv} / F_{yv})}{\sum_{v=V_1}^{V_n} \sum_{y=Y_1}^{Y_n} (t_{yv} / F_{yv})}$$

F_{yv} = fuel economy of MY subgroup y and vehicle type v
 $Y_1 \dots Y_n$ = various model years measured
 $V_1 \dots V_n$ = vehicle types measured
 f_{yv} = relative fuel economy of subgroup y and v

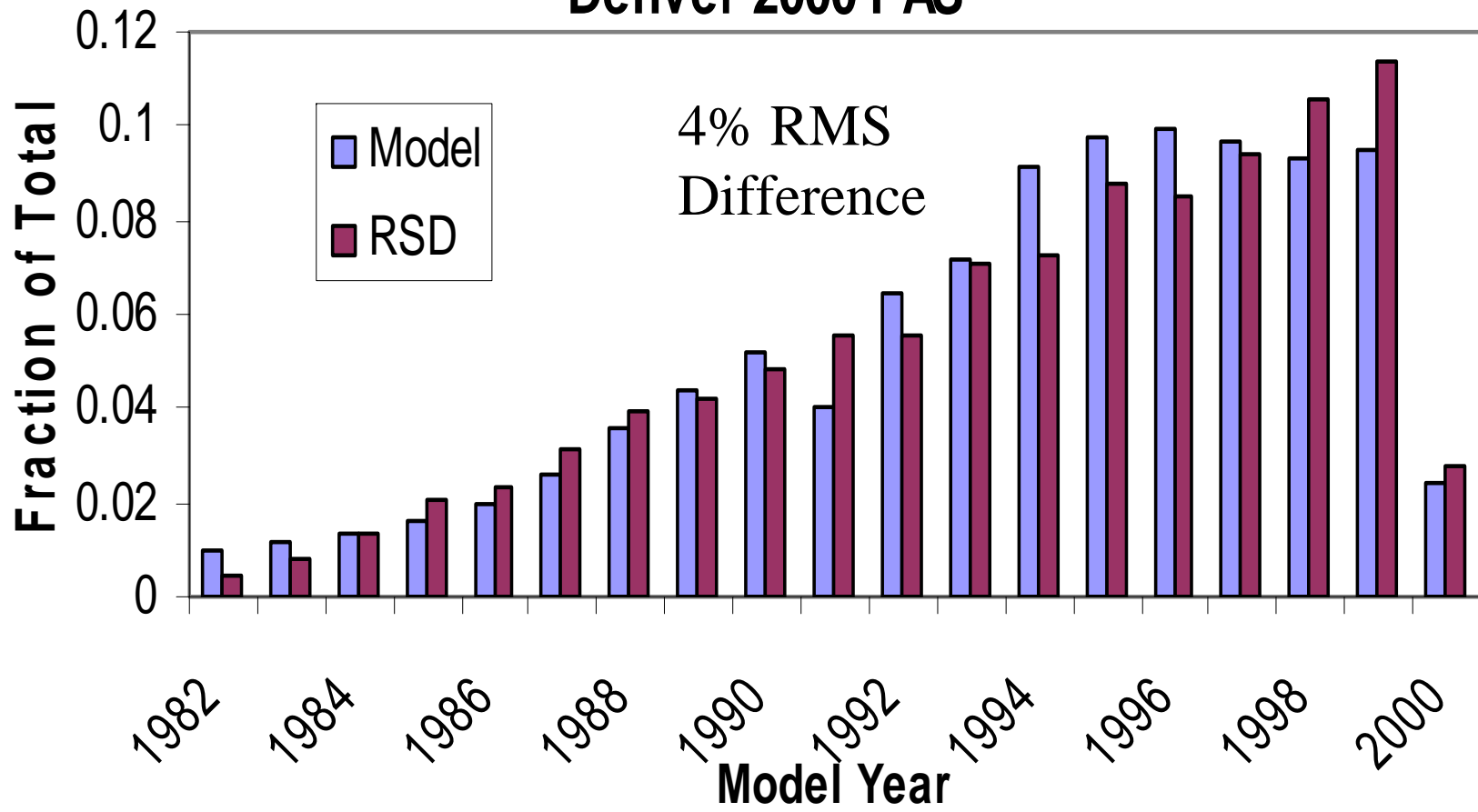
$$M = \sum_{v=V_1}^{V_n} \sum_{y=Y_1}^{Y_n} f_{yv} E_{yv}$$

M = Emission factor of fleet

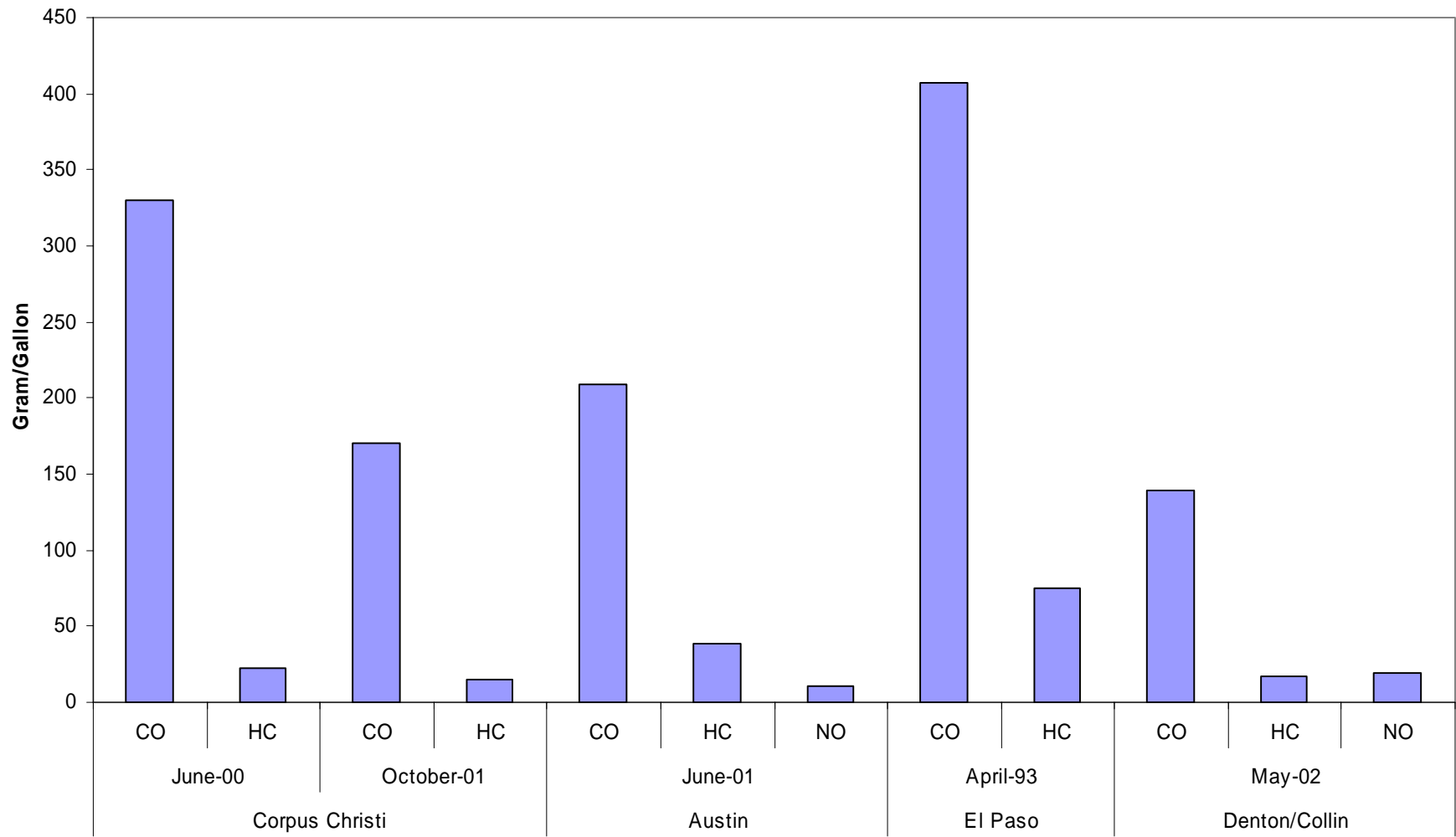
Statistics of Using RSD for Inventory

- One week's work
- 25,000 vehicles
- Approximately 5% variability in day to day average emissions
- Adding uncertainty in fuel economy and fuel sales in area: 10% overall uncertainty

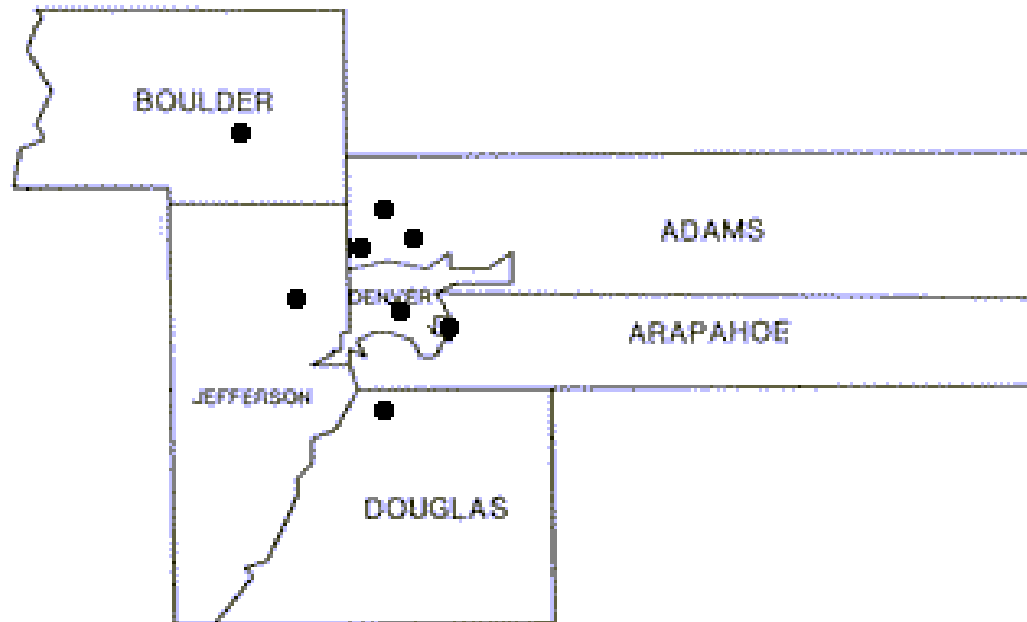
Model Year Distribution of RSD Measurements and Model Travel Fractions Denver 2000 PAS

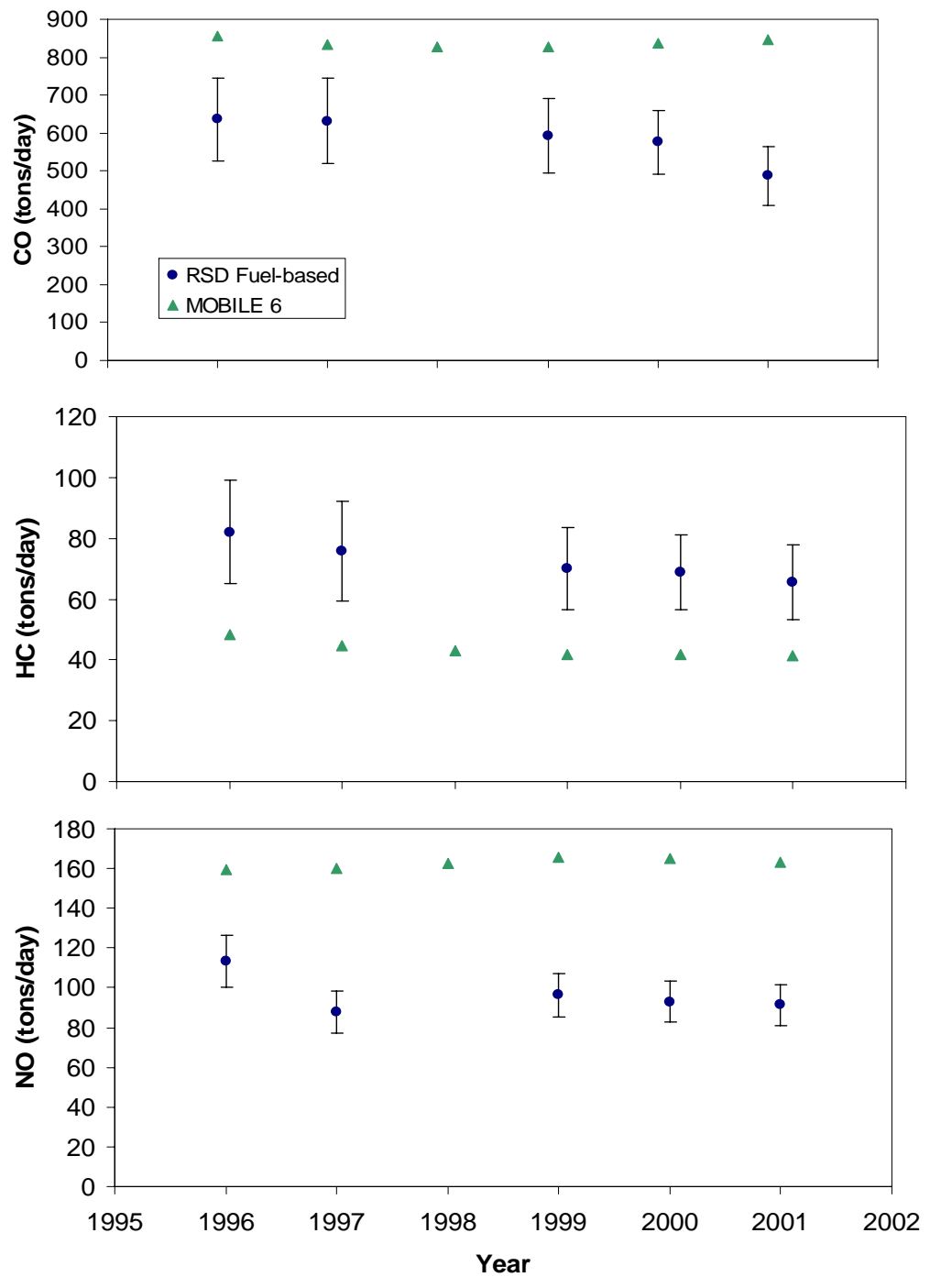


Texas on-road Emissions



Map of Denver Area with Measurement Locations





Implications

- RSD method ideal for mobile source emissions inventories
- Measurement and MOBILE disagree
- Only need one week of work and fuel sales to get fuel based emissions inventories with specified uncertainty.