Development of Agricultural Dust Emission Inventories for the Central States Regional Air Planning Association

Presented by

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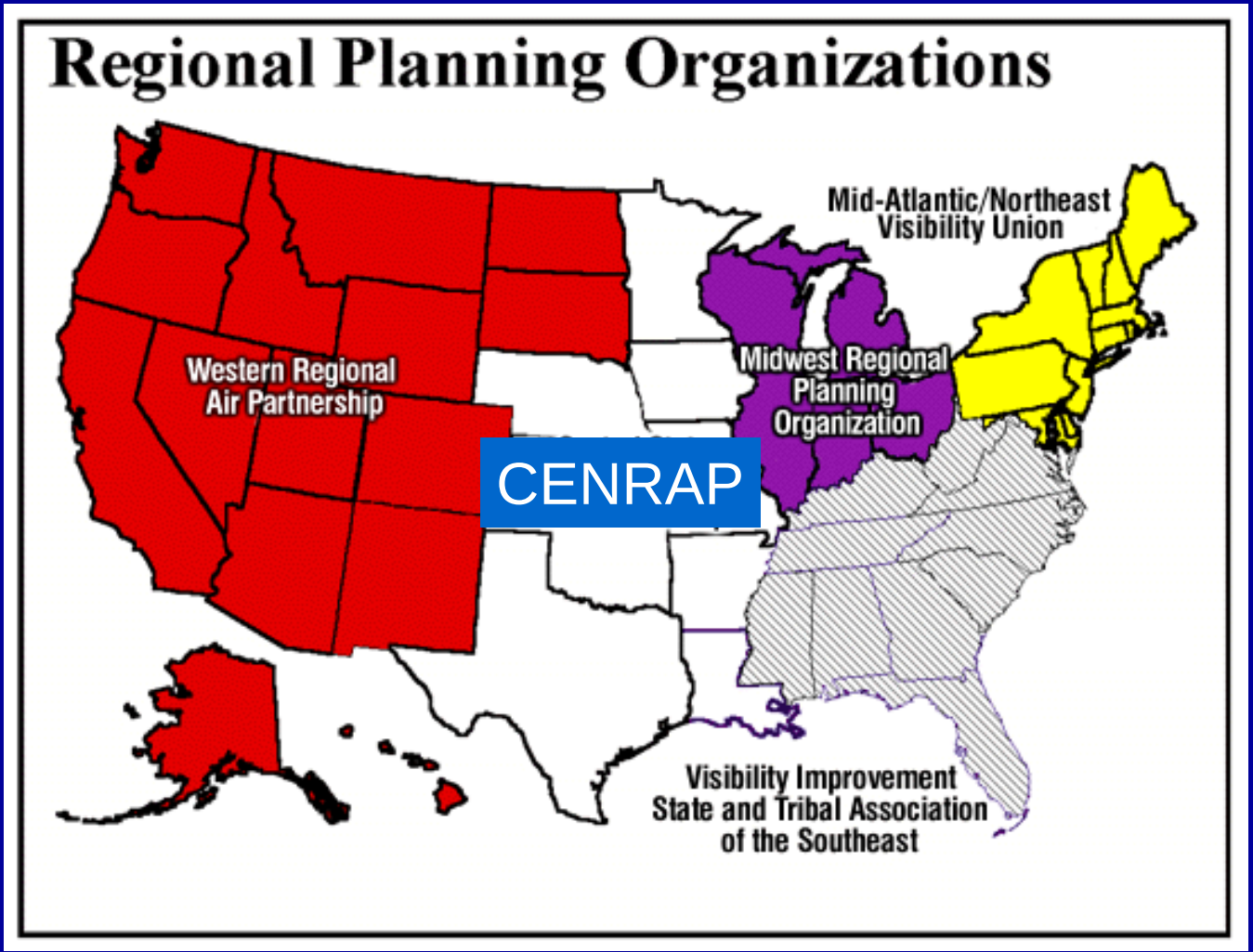
Project Objective

Develop county-level, year-2002 emission inventories of agricultural fugitive dust.

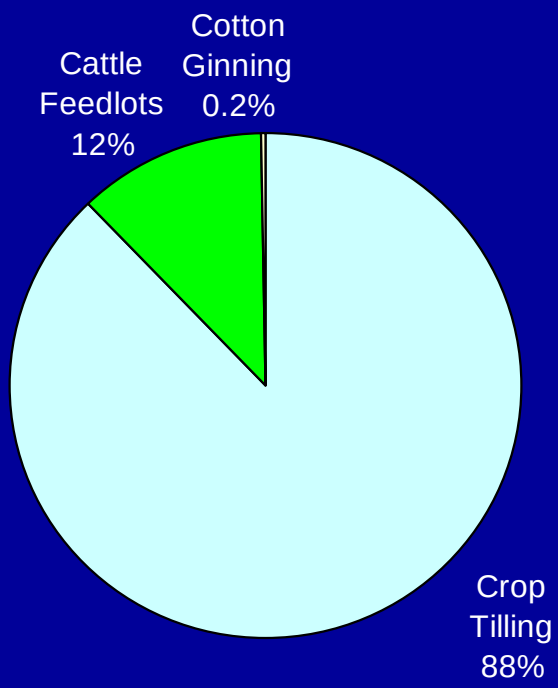
- Use bottom-up activity data and the best available emission factors.
- Generate annualized emission inventories (NIF3.0 format) and SMOKE-ready inventories (IDA format with ancillary files).

CENRAP Region

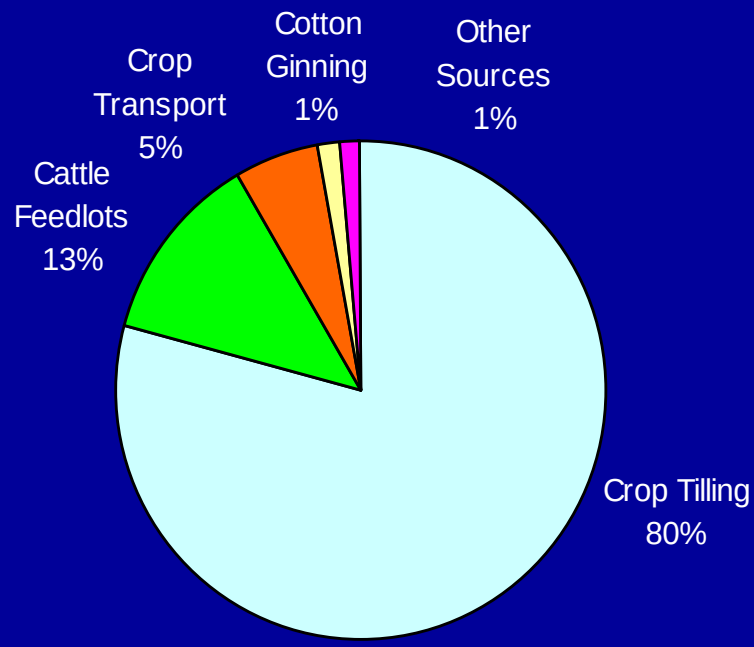


Source: http://www.epa.gov/air/visibility/regional.html

Likely Sources of Importance: Agricultural Tilling and CAFOs



1999 agricultural PM emissions for the CENRAP region



Projected 2002 agricultural PM emissions for the WRAP region

Sources: Preliminary 2002 NEI and WRAP

Methodology to Estimate Emissions from Agricultural Tilling Operations

$$E = c \times k \times s^{0.6} \times p \times a$$

E = PM emissions (lbs/yr)

c = Constant emission factor of 4.8 lbs/acre-tilling

k = Particle size multiplier (PM_{10}: 0.25, $PM_{2.5}$: 0.042)

s = silt content of the soil, defined as the mass fraction of particles smaller than 0.75 µm diameter found in soil to a depth of 10 cm

p = Number of tillings or passes performed in a year for each crop type

a = Acres of land tilled for each crop type

Activity Data Collection for Agricultural Tilling Operations (1 of 2)

Agricultural extension offices throughout the CENRAP region were surveyed for

- Number of tillings per year by crop type
- Temporal distributions of tilling activities
- Rate of occurrence of conservational tillings practices (i.e., no-till, mulch-till, and ridge-till)

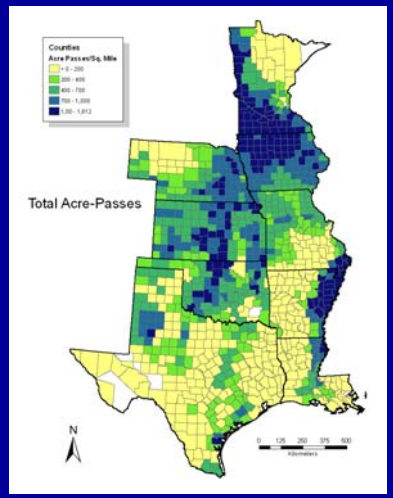
County-level crop acreages were acquired from the 2002 US Department of Agriculture National Agricultural Statistics Service (NASS).

Activity Data Collection for Agricultural Tilling Operations (2 of 2)

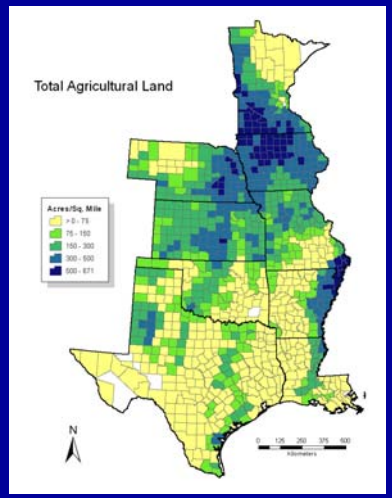
- Silt contents for various soil types were acquired from the EPA National Air Pollutant Emissions Trends Procedure Document.
- County-level soil types were acquired from the State Soil Survey Geographic Database of the U.S. Department of Agriculture.
- County-level silt contents were determined by cross-referencing soil types with silt contents.

Activity Data and PM Emissions from Agricultural Tilling Operations

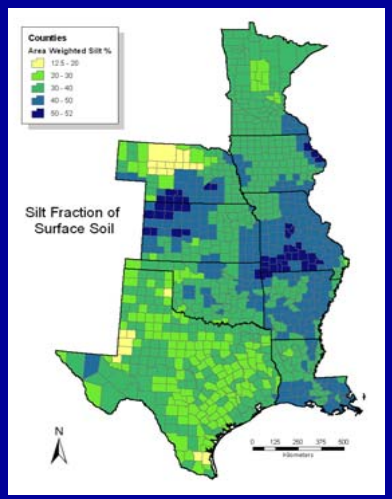
Tilling Activity Intensity

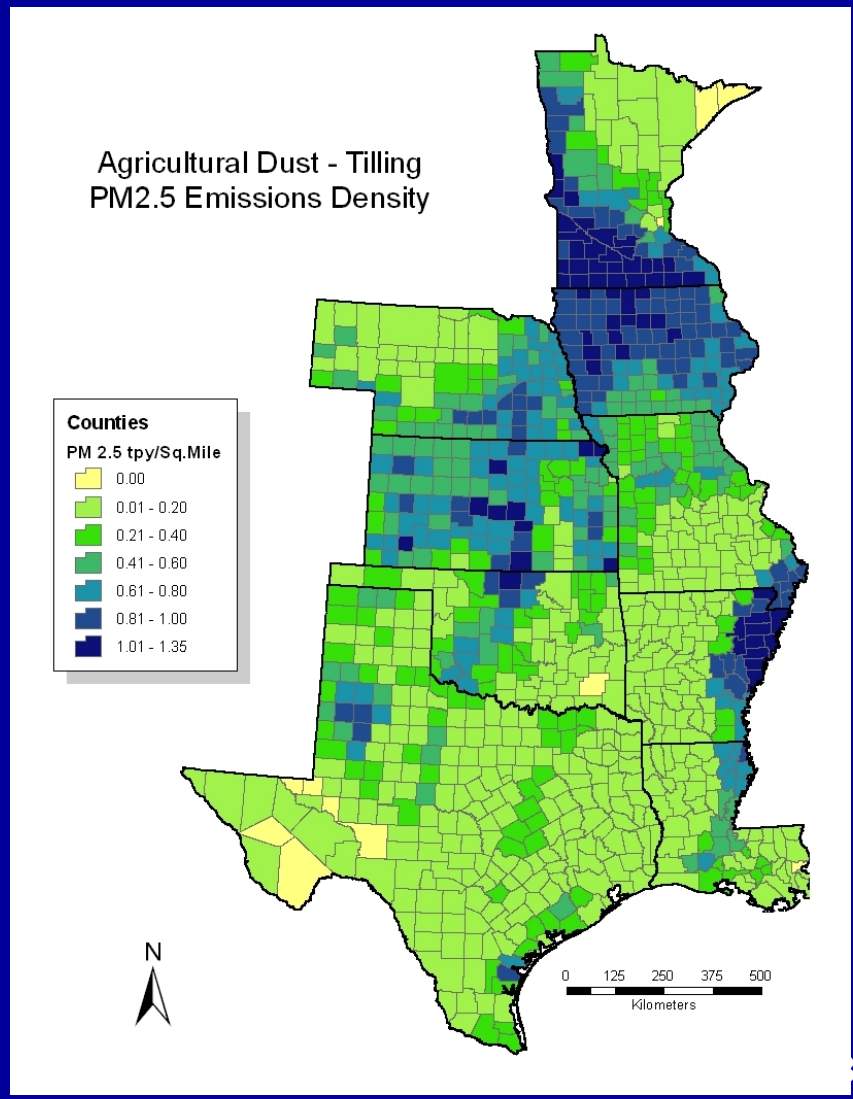


Agricultural Land Density

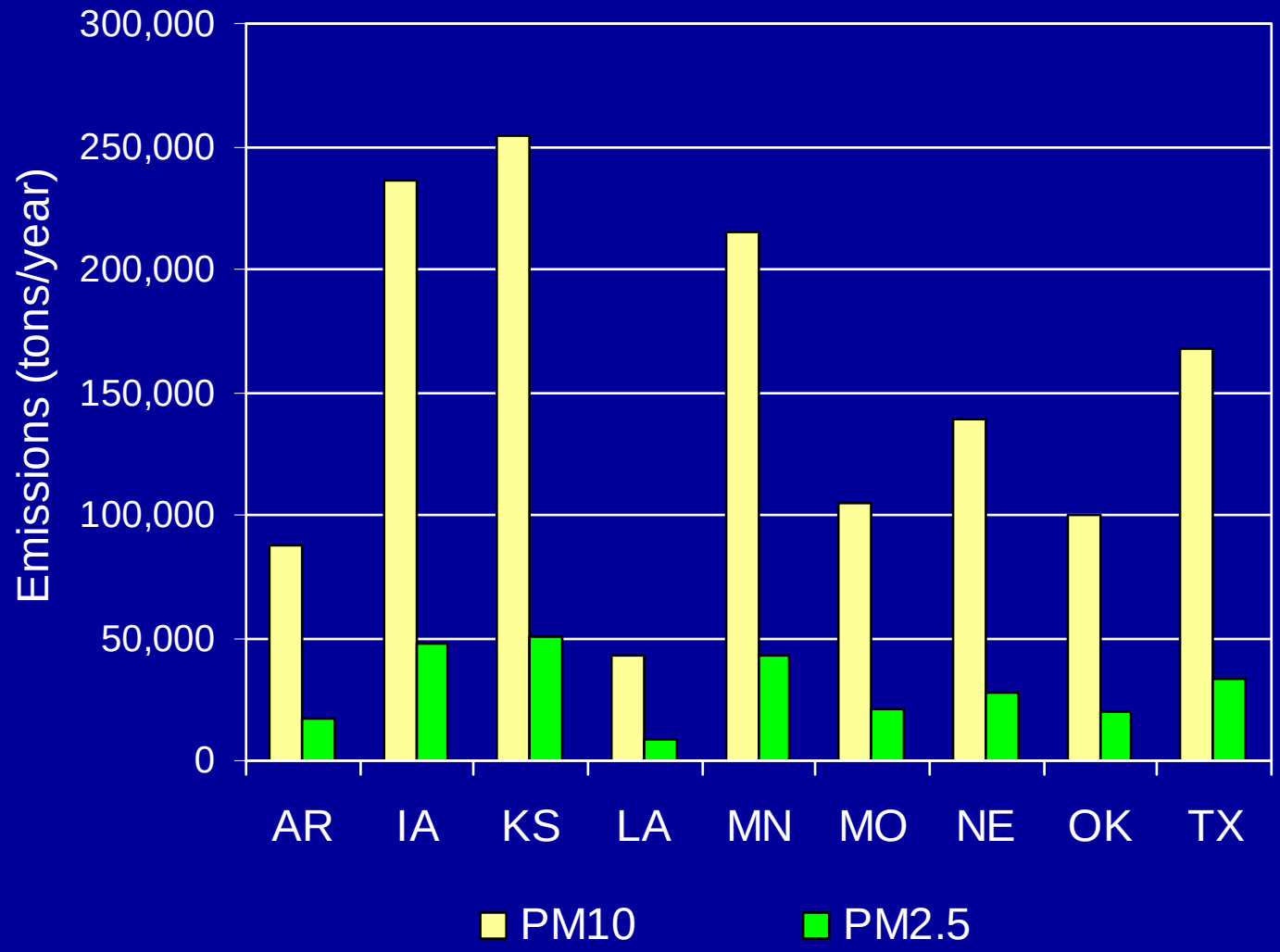


County-level Silt Contents

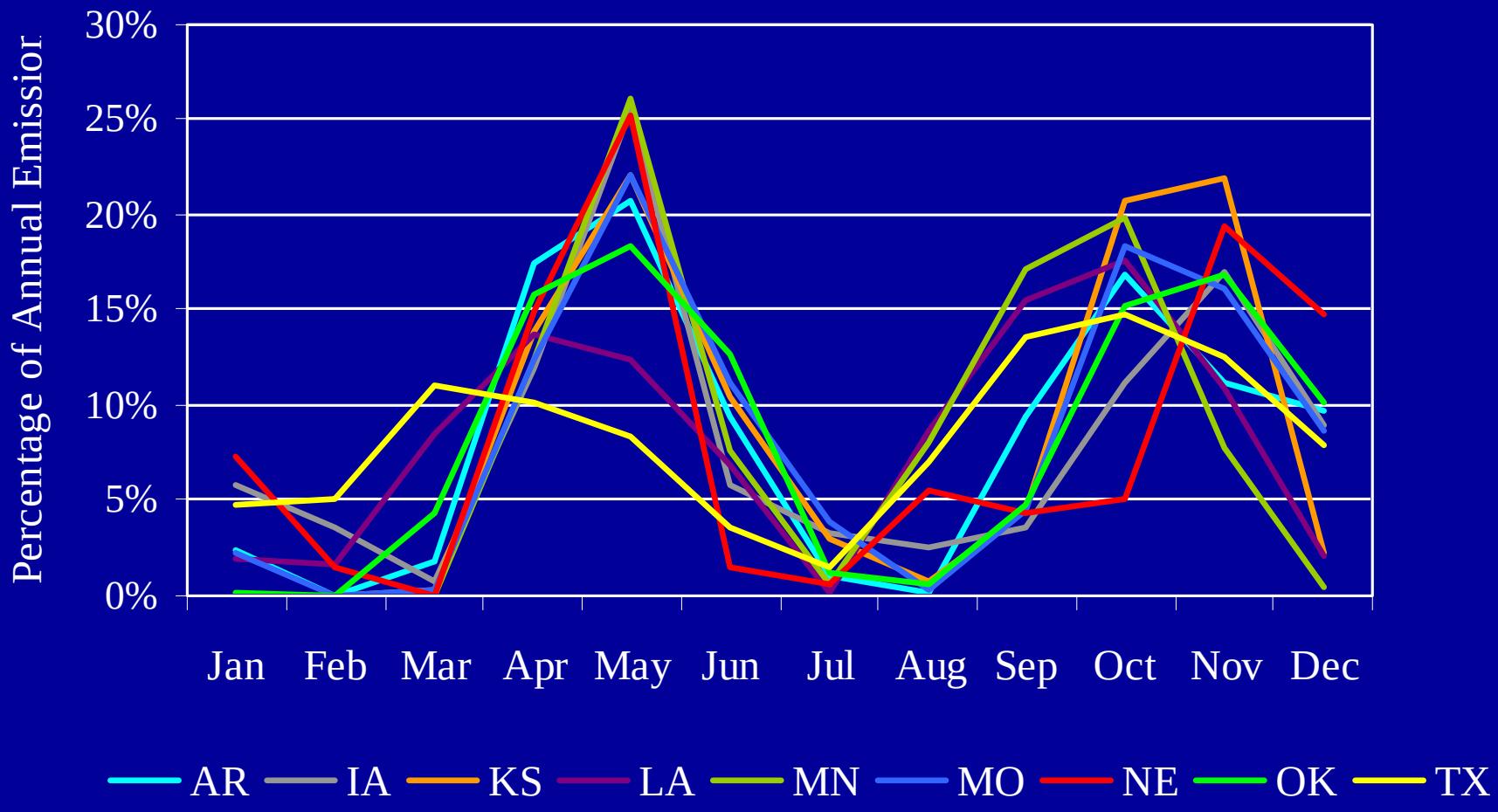




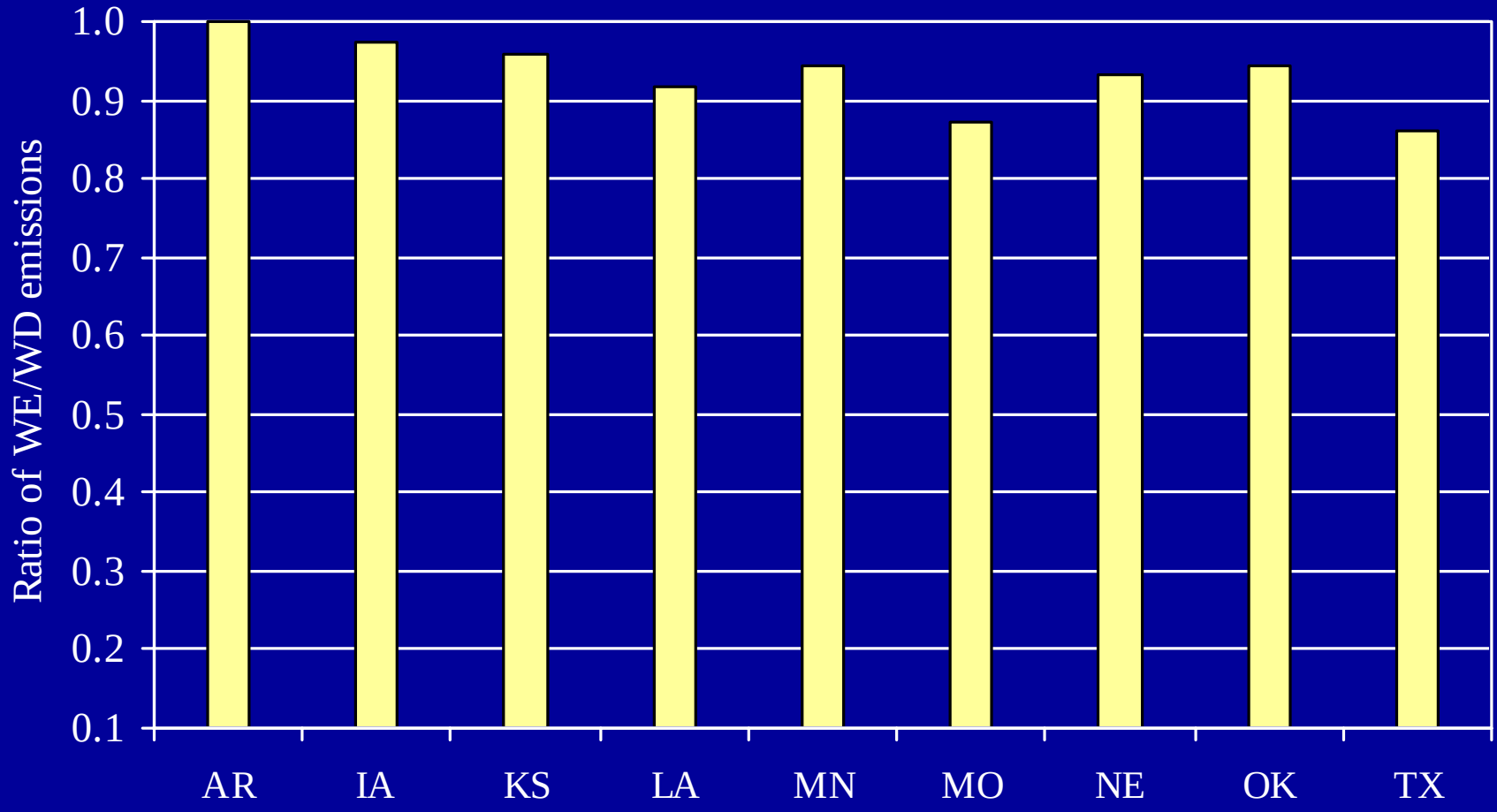
State-level PM Emissions from Agricultural Tilling Operations



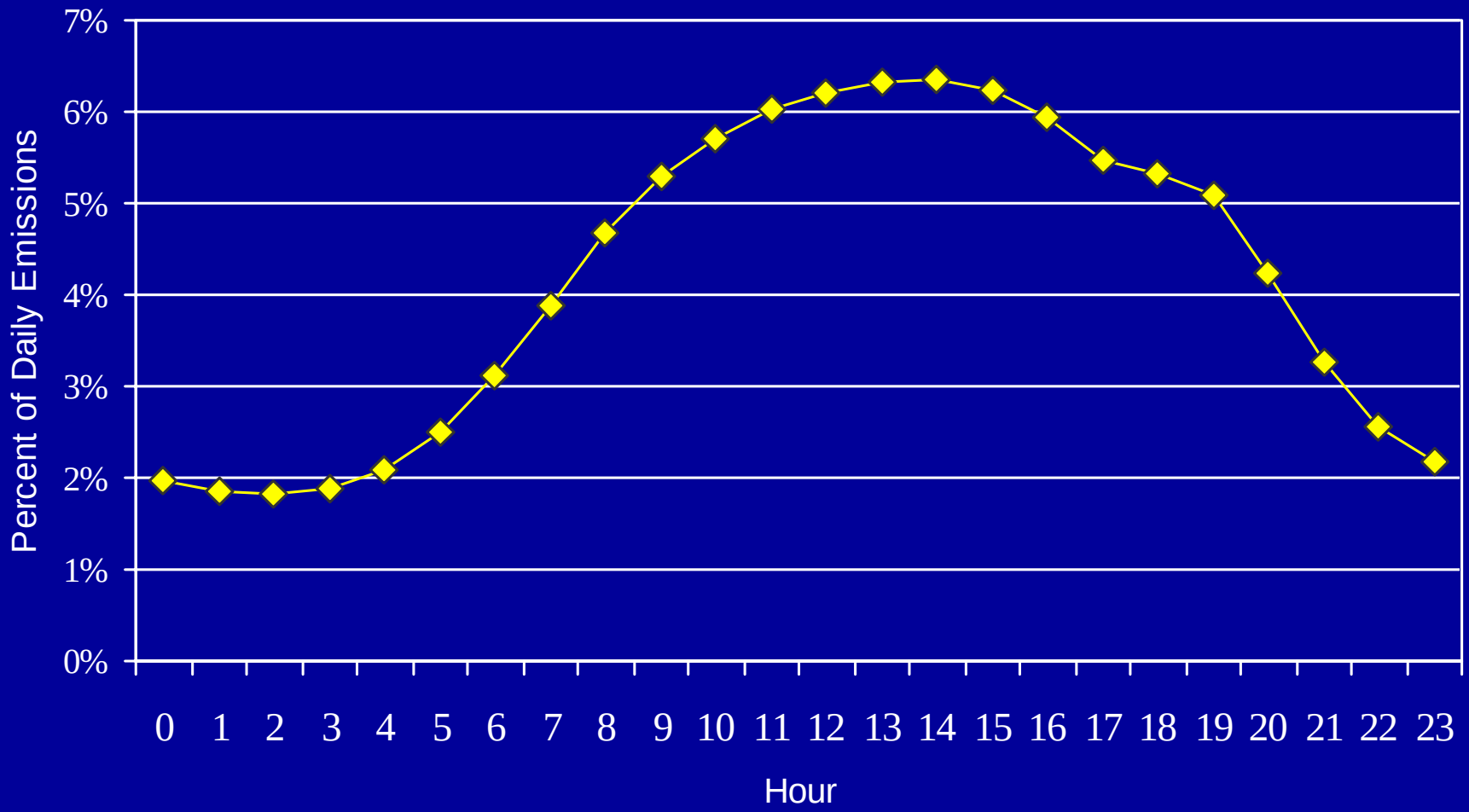
Monthly Variabilities in Agricultural Tilling Emissions



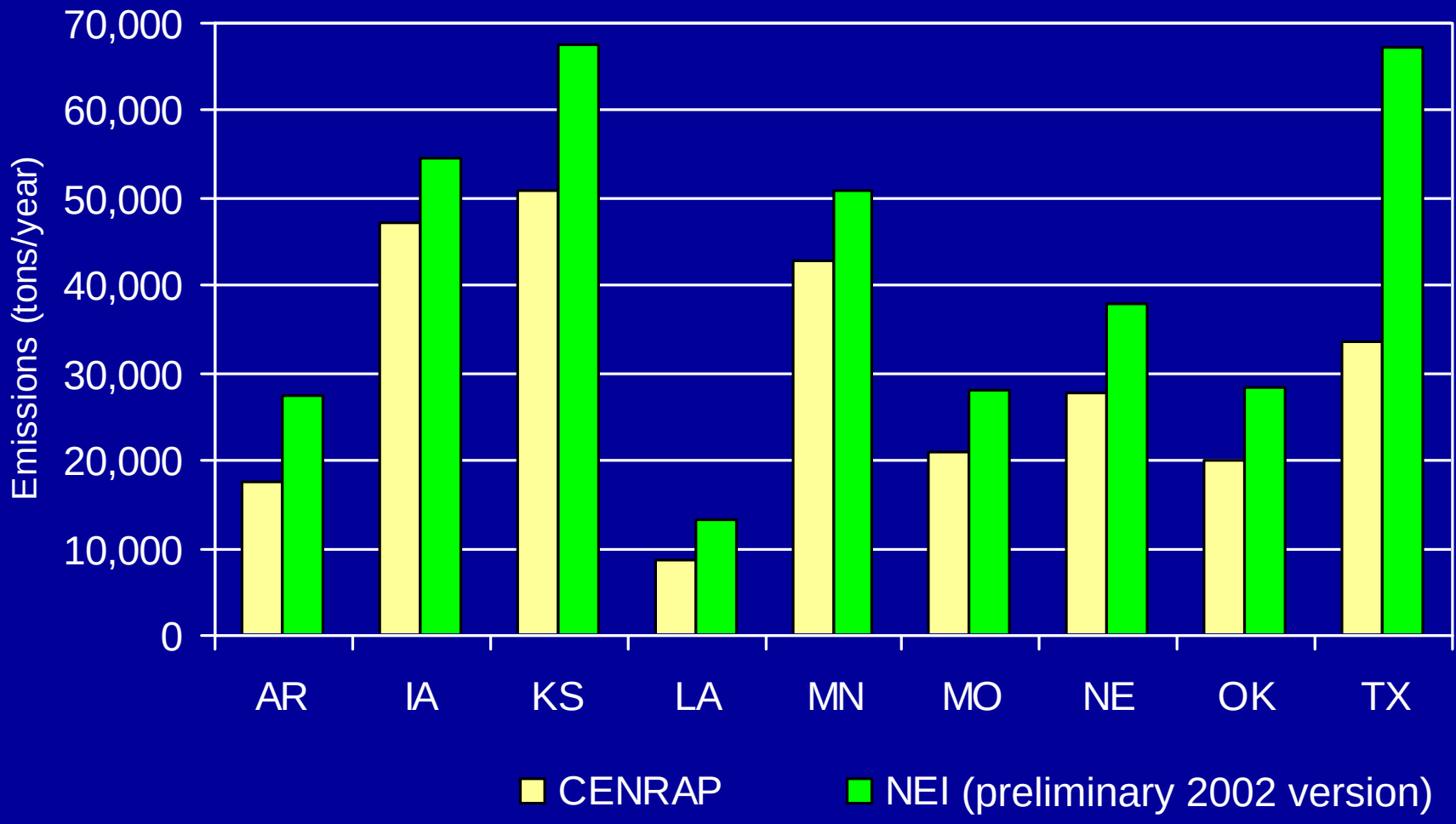
Weekday-weekend Variabilities in Agricultural Tilling Emissions



Diurnal Variability in Agricultural Tilling Emissions



Comparison of Top-down and Bottom-up Emission Inventories for Agricultural Tilling



Emission Factors for CAFOs

Emission factor from EPA guidance:

- 93 lbs of PM_{10} / 1,000 head of feeding beef cattle / day

Emission factors from a literature search:

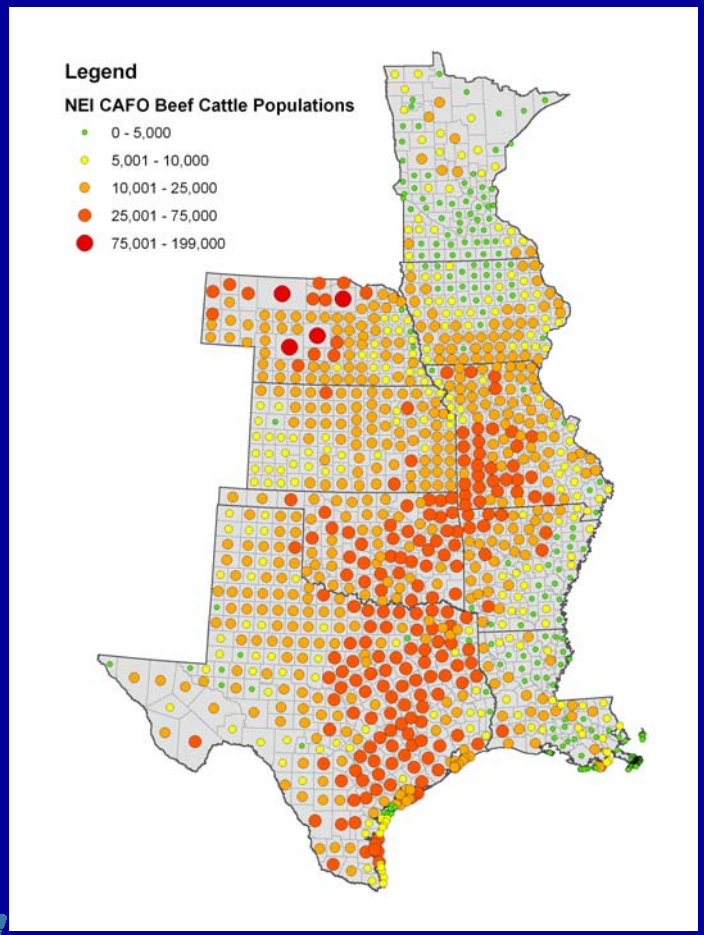
- 28.9 lbs of PM_{10} / 1,000 head of feeding beef cattle / day *(University of California at Davis, 2001)*
- 19 lbs of PM_{10} / 1,000 head of feeding beef cattle / day *(Texas A&M University, 2002)*
- 4.4 lbs of PM_{10} / 1,000 head of **dairy** cattle / day (*Texas A&M University, 2002)*

Selected emission factors for CENRAP:

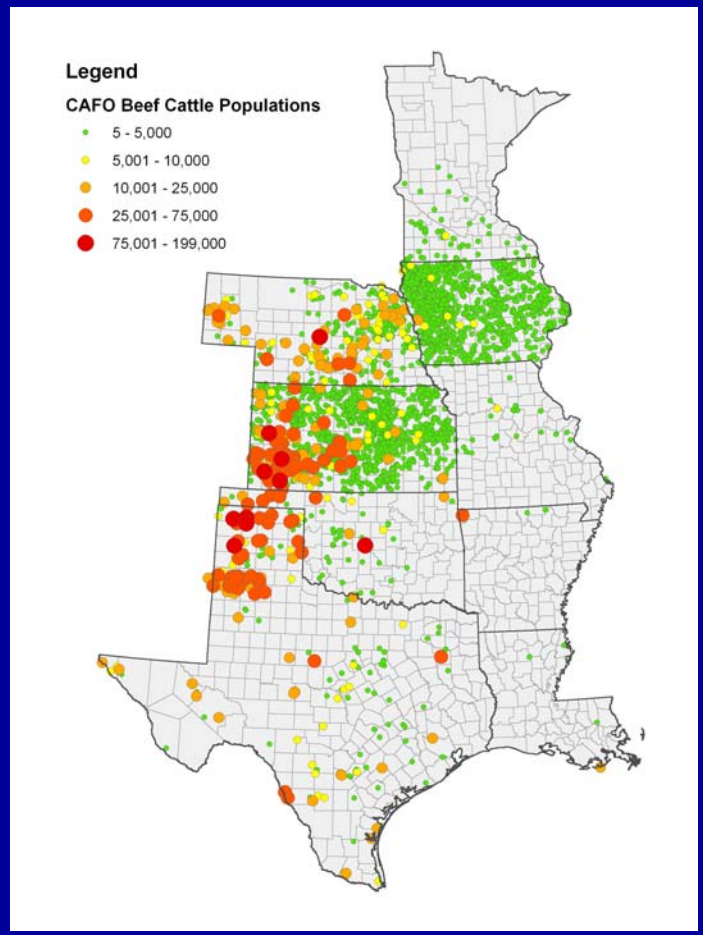
- 24 lbs of PM_{10} / 1,000 head of feeding beef cattle / day
- 4.4 lbs of PM_{10} / 1,000 head of dairy cattle / day

Comparison of Top-down and Bottom-up Geographic Distributions of CAFOs

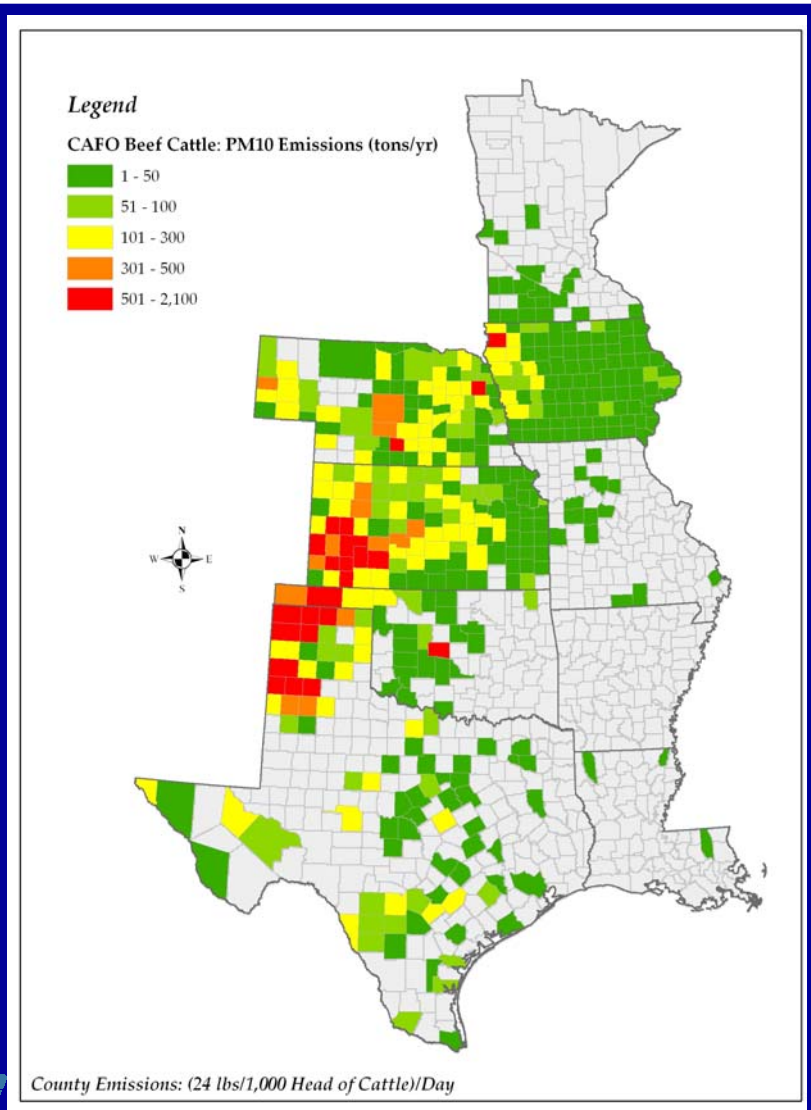
Top-down distribution based on county-level beef cattle populations

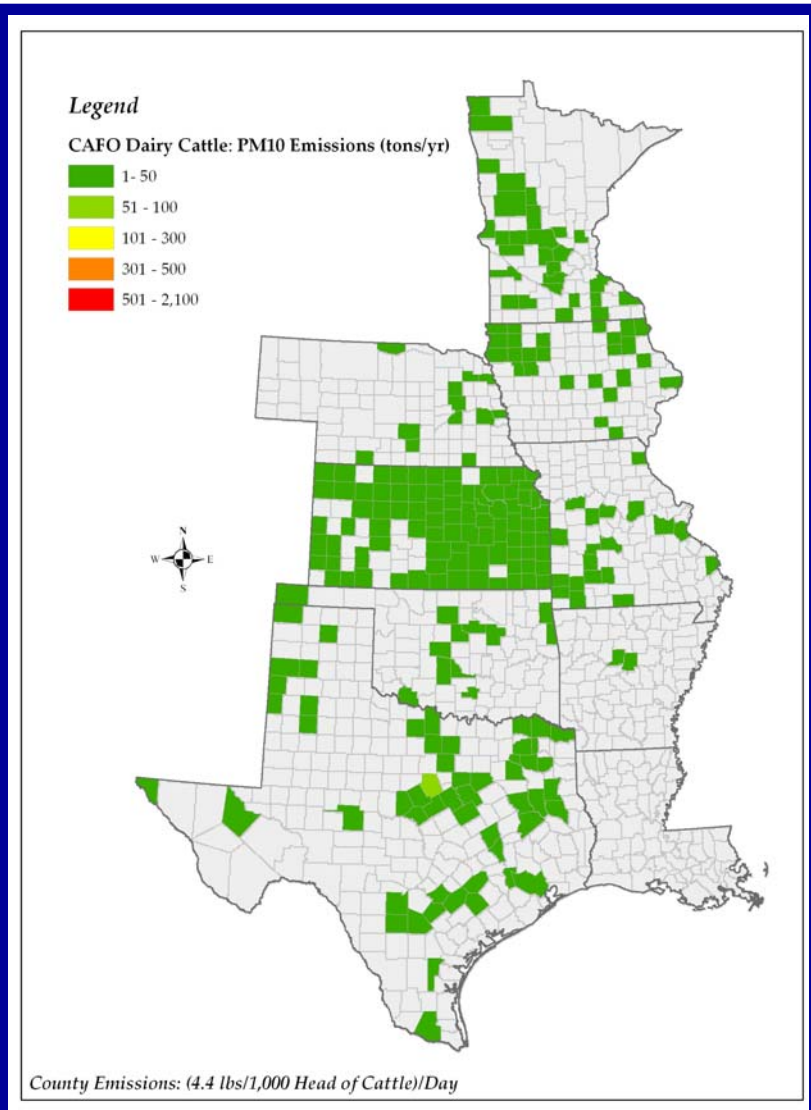


Bottom-up distribution based on NPDES records

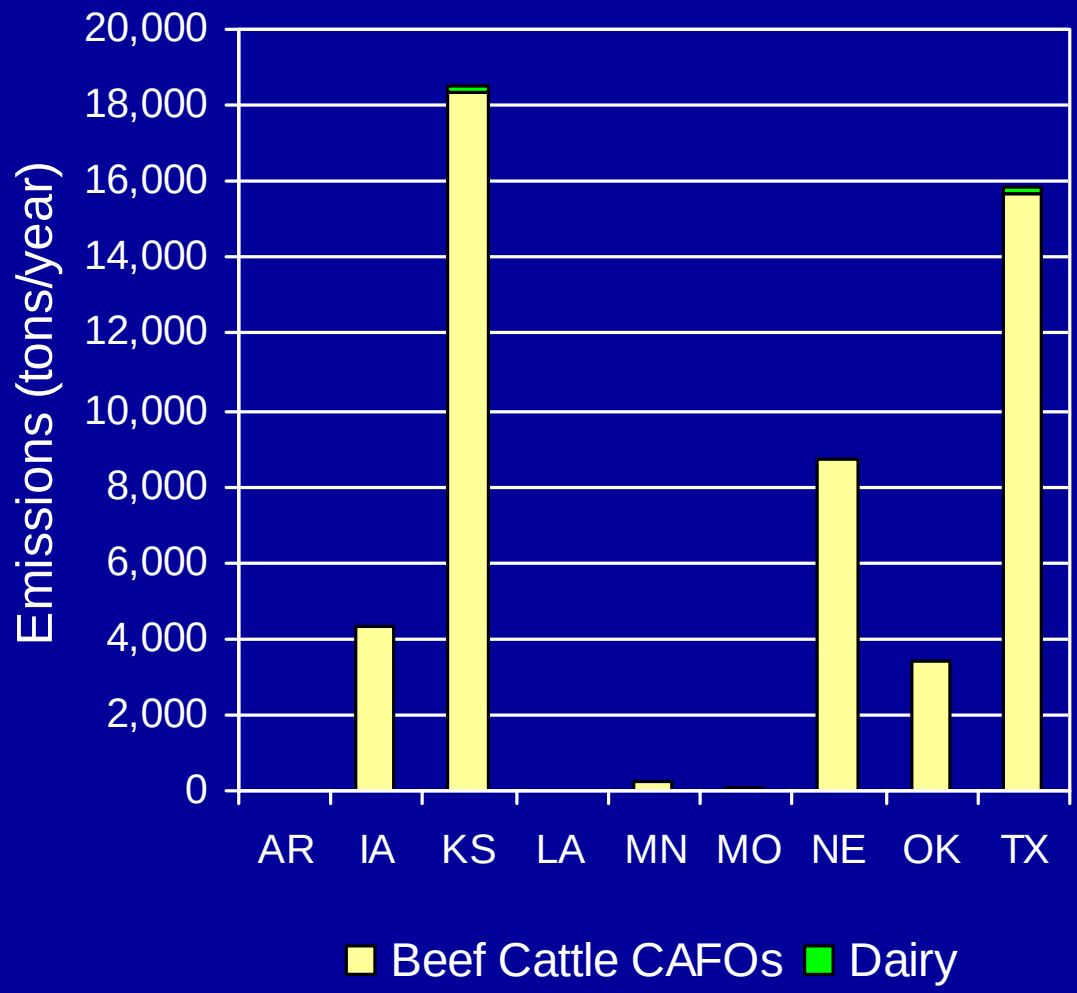


County-level PM_{10} Emissions for Beef Cattle CAFOs and Dairies





State-level PM_{10} Emissions for Beef Cattle CAFOs and Dairies



Conclusions

Take-home message: Using bottom-up data (instead of national-average or top-down data) makes a difference.

- Differences were 25% to 30% of state-level emissions.
- Differences in geographic distributions were dramatic.

Opportunities for Further Improvements

Develop process-based approaches for estimating emissions, which should account for

- Soil moisture
- Meteorological conditions
- Agricultural practices

Gather bottom-up activity data for additional sources of agricultural fugitive dust, such as cotton ginning and crop transport.

Glossary

CAFO = Confined Animal Feeding Operation

CENRAP = Central States Regional Air Planning Association

NEI = National Emissions Inventory

NIF = NEI Input Format

NPDES = National Pollutant Discharge Elimination System

WRAP = Western Regional Air Planning Association